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A Revision of the Nearctic Oedemeridae (Coleoptera)

Ross H. Arnett, Jr.

U. S. National Museum, Washington, D. C.

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Introduction

The two fathers of American Coleopterology, LeConte and Horn, have contributed the only comprehensive studies of the Nearctic Oedemeridae up to the present writing. Dr. Horn began his monograph with the statement that "It is now over forty years since Dr. LeConte published . . . a short review of the species then known to him." The same neglect of this family has persisted since Horn's 1896 study for over fifty years. I therefore find myself phrasing a similar introductory statement, lamenting the fact that so many years have passed without the study of the great amount of additional material of these heteromerous beetles that has accumulated in the various collections throughout the country.

The reasons for this neglect of taxonomic and biologic studies of the group are not difficult to perceive. The family is small in North America; the species are of practically no economic importance, and they are not particularly showy, hence not collectors prizes.

It is my hope, however, in presenting this study to my associates, that there will be more attention focused on this group, by providing an impetus for continuous collecting, and correct identification of material.

ACKNOWLEDGEMENTS

This work was carried out under the direction of Prof. W. T. M. Forbes, to whom the writer is indebted for much constructive advice. To other members of the staff of Cornell University, Professors Robert Matheson, Walter C. Muenscher, Henry Dietrich and V. S. L. Pate, the writer is also deeply obligated. To the curators of the various collections and to many collectors throughout the country, each of whom I have specifically acknowledged below, and to my associates at Cornell University, especially Dr. Howard Ensign Evans, who have offered many important suggestions and advice, my sincere thanks. Miss Barbara L. Lindner is responsible for transforming rough sketches into the finished drawings. Miss Mary Elizabeth Fernow drew the chart of the genera and helped with the drawings. Miss Helen Fedorka typed the manuscript, and Mrs. Marion Schickel proofread the final manuscript. My sincere thanks to them.

SOURCES OF MATERIAL

In one respect at least, this group has been easier to revise than most groups. Nearly all of the North American species were described by either LeConte or Horn and these types were readily available for study; the LeConte types in the Museum of Comparative Zoology and the Horn types in the Academy of Natural Science of Philadelphia.

The following is a list of the collections studied. The abbreviations used for the various collections when citing material studied in the following discussion of the species follows in square brackets, and it in turn is followed by the curator responsible for the loan in the case of institutions: American Museum of Natural History, [AMNH], (M. A. Cazier); United States National Museum, [USNM], (E. A. Chapin); Chicago Natural History Museum, [CNHM], (R. L. Wenzel); California Academy of Science, [CAS], (E. C. VanDyke); Museum of Comparative Zoology, LeConte Collection, [MCZ (LeC.)],* (P. J. Darlington); Academy of Natural Science of Philadelphia, Horn Collection, [ANSP (Horn)], (J. A. G. Rehn); Cornell University, [CU], (Henry Dietrich); Ohio State University, [OSU], (J. N. Knull); Alabama State Museum of Natural History, [Alab.], (Walter B. Jones); University of Miami, [Miami], (H. F. Strohecker); University of Idaho, [Idaho], (W. F. Barr); Reading Public Museum, [RPM], (Lawrence S. Dillon); Kenneth M. Fender Collection, [Fender]; Borys Malkin Collection, [Malkin]; George P. Mackenzie Collection, [Mackenzie]; A. T. McClay Collection, [McClay]; Barry D. Valentine Collection, [Valentine].

This, I believe, represents a very high percentage of the available material of Nearctic Oedemeridae.. In addition to this are the specimens in my own collection which I have indicated as: [Author].

From this material I have been able to study all of the Nearctic species except for two species placed in this family by various authors: *Lagria rufifrons* Fabricius (Mant. Ins., 1: 93, 1787.), and *Oederma vestita* Say, (Journ. Acad. Nat. Sci., Phila., 3: 273, 1823). Both of these are assigned to the genus *Asclera*, but for no valid reason as there are no characters given in the descriptions which would indicate such an assignment, and of course, the types are lost.

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* Many of the specimens in the LeConte collection have small colored discs on the pin which are a key to the locality where they were collected. A chart showing these colors, which are now greatly faded, is available with the collection. In the following citations of types from this collection, I have indicated the color and shape of the disc and given the locality which the disc stands for.

HISTORICAL

Olivier in the *Encyclopédie Méthodique,* 1789 established the genus *Oedemera* for certain European species with swollen hind femora in the male sex. The last edition of the *Dejean Catalogue,* 1837, lists approximately eighty-five species in what we now recognize as Oedemerid genera, but not as a family unit. Latreille, however, in 1825 grouped certain heteromerous genera into what he called *Oedemerites,* and hence it was he who first recognized this family. Stephen's *Manual of British Coleoptera,* 1839, gives a general account of all of the British species of Oedemeridae then known, with a description of several new genera.. There were other general accounts of the family contemporary with Stephen's account included with a general discussion of beetles, but nothing of a monographic or revisional nature appeared until 1846 when Dr. Wilhelm Schmidt presented a revision of the European Oedemeridae as the first article in the new publication, *Linnaea Entomologica.* This provided us with a sound foundation and is the basis of all further work on the family. This culminated in 1899 in the great monograph by Seidlitz which treated all of the then recognized genera.

Turning now to the new world, we find that only three authors have contributed materially to our knowledge of the new world fauna. They are LeConte, Horn, and Champion. LeConte's synopsis of the Oedemeridae of the United States appeared in the proceedings of the Philadelphia Academy of Natural Science in 1854. In it he reviewed all of the then described species, placing some in synonymy and describing several new species himself. He followed this in 1866 with keys to the genera *Copidita* LeC. and *Oxacis* LeC. and descriptions of seven new species. Champion in 1889 in the great work *Biologia Centrali-Americana* gave an excellent review of the Central American species of this family, suggesting certain generic changes and providing us with practically the only colored drawings of Oedemerids. A few of the North American species are there discussed and changes suggested in their generic association. This prompted Horn to publish in 1896 in the proceedings of the California Academy of Science a thorough review of the boreal America species and to describe many new ones. This has remained until the present time our only tool for the identification of Oedemeridae.

Nomenclature

In the following discussion of the species and higher categories, I have given only the pertinent references to the literature, but have attempted to give a complete catalogue of every name proposed for the group involved in the Nearctic Region. I have mentioned such corrections as are necessary, and refer the reader to the Junk/Schenkling *Coleopterorum Catalogus,* pars 65, 1915 for more detailed references. Wherever incomplete reference citations are given in the text, the complete reference may be found in the bibliography at the end.

Descriptive Terms

A number of innovations in terminology have been made in the following descriptions. The biggest change is in the nomenclature applied to the various

parts of the male genital organs. The accompanying illustrations are labeled in detail and will thus serve to identify the parts. The reader is referred to Sharp and Muir's paper, (Trans. Ent. Soc. London, 1912, pp. 477-642, 78pl.) page 481 and pages 484-485 for a discussion of terms used for the parts of the male copulatory organs. The following list defines either new terms, or terms used in a restricted or modified sense in this paper:

Male genitalia—Here equals male copulatory organs because of the inclusion of the modification of the abdomen itself, and is not restricted to the male genital tube.

Tegminite—The scleritized portion of the membraneous tube which connects sternite nine with the basal piece. In the Oedemeridae it lies ventral and parallel to the basal piece.

Paramere—The apical piece of the tegmen which in the Oedemeridae equals the "lateral lobes."

Tegmen—The tegminite, basal piece and paramere together.

Basal process—A median, dorsally curved basal portion of the median lobe.

Basal plates—The expanded base of the basal piece of certain Oedemeridae.

Sub-basal apodeme—A chitinous rod which extends dorsally, situated slightly apically from the basal entrance of the sperm duct in the median lobe.

Median lobe—The chitinous lobe which contains the sperm duct and the internal sac.

Apical lobes—The lobes of the paramere.

Apodeme—A basally projection process to which muscles are attached.

Junction point—The point in the male genitalia of Nacerdinae at which the eighth and ninth tergite and sternite join, (see plate III, fig. 9a and 10a).

Rugose-punctate—Punctures indistinct because of an irregular or rugose surface.

Piceous—Dark colored, but not "jet" black.

Testaceous—Pale colored or the color of unpigmented chitin.

Griseous—Ashen gray.

Cultriform—Usually means shaped like a pruning knife, but here applies to the shape of the apical segment of the maxillary palpi when it is slender, somewhat curved, and the widest point is at the base.

In the following account, I have described the type specimens in all cases when available. If the type was not available I have described a single example of what I consider as typical. Following this description I have indicated the individual variation of the series studied. In no case were the male genitalia of the type specimens, other than the species here described as new, examined.

Biology

The biology of the various species of Oedemeridae is practically unknown. All of the records of the larvae known to me indicate that, in general at least, they are inhabitants of wood. The larvae of *Nacerdes melanura* (L.) are reported in drift-wood along the coasts of the Oceans and large rivers. They have also been reported in pilings along the docks in Montreal, Que. The larvae of *Oxacis bicolor* (LeC.) are found infesting "dry rot" flooring and woodwork in buildings. Various other species such as *Calopus angustus* LeC. and *Ditylus* sp. have been collected under the bark of various conifers. Other than these scanty records, the larvae are unknown.

The adults are collected from sweepings over various flower heads and leaves. The records are few, and hence no generalities can be made as to flower preference. Such plants as palms, palmettos, dogbane, Russian thistle,

and so on are some that are cited under the biology discussion in the following account of the species. Many of the species have been collected at lights.

There are some interesting notes with specimens of *Oxacis bicolor* (LeC.) adults which were collected in mines in both Colorado and California. They are said to have bitten the workmen in these mines, causing "severe inflammation and swelling." This urticating ability is also reported for one or two species from some of the Pacific Islands.

Taxonomy

MORPHOLOGY

The family Oedemeridae in general may be characterized as medium sized beetles with the tarsal formula of 5-5-4, i.e., they are heteromerous. The anterior coxal cavities are open behind. The antennae are filiform, rarely subserrate. The legs are slender, except for the genus *Oedemera* which has the hind femora large in the male sex. The thorax is always without ridges or margins, widest anterior to the center, and posteriorly narrower than the elytra. The head is small, deflected. The maxillary palpi are large, the apical segment always broader and larger than the others. The elytra cover the abdomen. The male genitalia have the tegminite of the tegmen distinct from, and lying dorsal to the paramere, the basal piece always solidly united or fused to the paramere without trace of a suture.

Head.—Small, narrower than the thorax, generally longer than broad, sometimes much longer than broad, greatly elongate, (e.g. *Rhinoplatia*), neck absent, prothorax slightly covering the base of the head. The eyes are usually large, oval, and often emarginate near the insertion of the antennae. Rarely, the eyes are very deeply emarginate with the antennae inserted within this emargination, (e.g. Calopodinae). The mandibles are moderately stout, usually acute at the apex, sometimes bifid, and in one genus, *Alloxacis*, only the right mandible is bifid. Sometimes the mandibles are very stout, apex blunt and deflected, (e.g. some *Oxacis*). The antennae are eleven segmented. In some males there appears to be a twelfth segment because of a median ring at the center of the eleventh segment. This annulation varies considerably in the different species. In some it is barely perceivable, while in others it seems to be a distinct joint. However, in all cases, this ringed segment does not exceed the length of the preceding segment. The individual segments vary in length from species to species, but are uniform for any given species. The second segment is usually much smaller than the others. The maxillary palpi are always four-segmented, with the apical segment the longest and broadest. The apical segment is usually triangular in shape or may be cultriform. The shape of the triangle varies with the species, and also with the individuals of certain species. It may be widest at any point along the side. In rare cases there is an apical angle so that the shape of the segment is more like a trapezium than a triangle.

Thorax.—The notum is always broader apically than basally, the base narrower than the elytra. The margins of the notum are rounded, never a ridge. Sometimes the head is partly covered by the anterior margin of the

thorax. The legs are slender; the hind femora are not expanded in any Nearctic species. The tarsi are slender except for the penultimate segment and sometimes the antepenultimate, which are heart shaped, or bilobed. The ventral surface of one or more tarsal segments may be spongy beneath. The elytra are uniform in shape throughout the family. They always cover the abdomen, are as wide subapically as basally, abruptly narrowing before the apex which is acute. The surface may be costate, depending on the species. The wings are typical Heteromera, but with venation reduced, close to *Penthe* in the Melandryidae, (see Pl. I, fig. 1.).

Abdomen.—The abdomen always has five visible sternites, (sternites nos. 3-7), and the eighth and ninth may sometimes be visible in the male depending on the position when killed. The eighth and ninth are modified in the male to form a part of the male genitalia. The seventh sternite may be apically evenly arcuate, rarely truncate and often emarginate, sometimes nearly bilobed.

Male genitalia.—The use of the male genitalia as a basis for classification in the Coleoptera as well as a basis for distinguishing the species has become increasingly popular since the appearance of Sharp and Muir's paper (loc. cit.). Male genitalia as used by these authors and those who have followed has meant essentially those structures situated between the ninth and tenth abdominal sternites, (when the latter is present), or between the ninth sternite and the anus. (See Pl. I, fig. 2.) By limiting themselves to the median lobe and tegmen, (probably for practical reasons of time, space for publication, etc.), they have neglected many important characters. The following study, in which I have used the eighth and ninth abdominal segments as well as the structures between the ninth sternite and anus should serve to illustrate this point. These last two abdominal segments are greatly modified, and have given me a far better basis for classification than many of the other structures, and have supported the characters found in the more external morphology. Unfortunately, these abdominal segments are not so modified into genital armature in all groups throughout the order. But when they are, and I believe that a goodly percentage of the beetles do have some modification in the apical abdominal segments, they should be used. Further exploration of these structures should serve to clear up some of the apparent inconsistencies in our present classification of "genitalia *versus* larvae *versus* wings."

The apical segments of the abdomen and the male genitalia of *Nacerdes melanura* (L.) (Pl. III, fig. 13.) will serve as an example of the basic structure involved.* In *Nacerdes melanura* the seventh segment consists of two plates, the tergite and the sternite, each deeply emarginate at the apex, the tergite less than the sternite. On each interior face there is attached a membrane at the position of deepest emargination and across the entire face. In each case the membrane is a continuation of the chitinous pocket formed by the apical lobes. This membrane forms a sheath around the eighth segment and is attached at the base of the latter's tergite and sternite. The eighth

* See Arnett, R. H., Jr., Coleopterists' Bull., 3: 9-12, 1949, for further studies on the morphology of Oedemerid genitalia.

sternite is deeply lobed forming two parts; each lobe is scoop-shaped. The eighth tergite has two parts, each with an apical lobe terminating near the three hooks at the apex of the ninth sternite. The ninth sternite consists of two rods forming a Y with three recurved hooks at the apex and a broad lobe for attachment at the side of the tergite. The tergite is heart-hraped with two basal "tails." The median lobe and the paramere fit into a tube which is the invagination of the connecting membrane to the apex of the ninth sternite and ninth tergite; the ventral side of the tube has a chitinous plate which is the basal piece of the tegmen, here called the tegminite. The paramere, the basal piece, and the tegminite together form the tegmen. The anal tube runs into this membrane between the ninth tergite and the tegmen dorsally.

From this basic structure there is a relatively great degree of modification which gives distinct generic characters. This may be best shown by the accompanying chart, (p. 264) which shows generalized sketches of the various parts as modified in the genera.

RELATIONSHIPS OF THE NEARCTIC MEMBERS OF THE FAMILY TO THE WORLD FAUNA

There are approximately one hundred genera and one thousand species recognized as belonging to this family. These are divided into three subfamilies, the subfamily Calopodinae, the subfamily Nacerdinae, and the subfamily Oedemerinae, the latter being further divided into three tribes, the Ditylini, the Asclerini, and the Oedemerini. The exact limits of these categories are as yet insufficiently worked out, making it impossible to study distribution above the generic rank.

By far the greater number of species are found in the tropical portions of the globe. The following table of genera represented in the Nearctic fauna offers certain clues to the history and origins of these genera:

TABLE I.

	Cosmopolitan	Palearctic	Neotropical	Ethiopian	Oriental
Calopus		×			
Sparedrus		×	×		
Xanthochroa	×				
Nacerdes	×				
Ditylus		×		?	
Heliocis					
Eumecomera					
Sisenes			×		
Oxacis			×		
Alloxacis			×		?
Asclera	×				
Copidita					
Rhinoplatia					

At present, evolution seems to be in progress in two of the subfamilies, Nacerdinae and Oedemerinae. The subfamily Calopodinae is probably ancient and rapidly disappearing. Three of the genera seem to be ancient since they

	8TH ABDOMINAL		9TH ABDOMINAL		TEGMEN		MEDIAN
	TERGITE	STERNITE	TERGITE	STERNITE	TEGMINITE	PARAMERE	LOBE
SCRAPTIA					ABSENT		
CALOPUS						D-L	
SPAREDRUS							
XANTHOCHROA							
NACERDES							
DITYLUS						D	D
HELIOCIS						D	D
EUMECOMERA						D	D
SISENES						D-L	D
OXACIS						D	
ALLOXACIS				L			
ASCLERA							
COPIDITA					ABSENT		
RHINOPLATIA							

are cosmopolitan with spotty distribution. Where these widespread genera started cannot be determined. The only fossil records we have are from the Colorado Miocene, but no relationship has been demonstrated. The most derivative genera are common to the Neotropical fauna, while the more primitive are common to the Palearctic fauna.

Relationship of the Family Within the Order

The exact placing of the Oedemeridae in the Order Coleoptera remains uncertain. As a result of the present study, the data seem to indicate that they are quite distinct from other groups, except in general *habitus*. Certain tendencies can be pointed out as is done below, but until further studies are made in the many groups of "heteromerous" genera which make up the Tenebrionoidea, the affinities cannot be clearly stated and understood.

One of the relatives of this family is the species of *Scraptia*, a genus which is usually placed in the Melandryidae, or sometimes set apart as a separate family. It will be at once noted (Pl. I, fig. 4 and Chart I, p. 264) that the essential difference between *Scraptia* and the Oedemerids is that the tegminite is absent and there is a distinct suture between the basal piece and the paramere.

Cephaloon, in general appearance, must be considered a close relative. But genitalic structures (Plate I, fig. 3) show that they are closer to the Tenebrionids. In *Cephaloon* the basal piece is the largest part of the tegmen, the paramere becoming simply the lateral lobes as are usually found in the Coleoptera.

Account of the Genera and Species

Family Oedemeridae Latreille

Oedemerites Latreille, Fam. nat., p. 380, 1825.
Oedemeridae, Stephens, Ill. Brit. Ent. Mandib., 5: 52, 1832.

The Oedemerids may be briefly defined as slender, usually soft-bodied beetles of medium size, found mostly on flowers and foliage. The antennae are eleven segmented, rarely appearing twelve-segmented, usually filiform, rarely sub-serrate. The pronotum is narrower at the base than the elytra, and wider apically. The head is slightly inserted into the prothorax. The tarsi are heteromerous; the front coxal cavities open behind, front coxae confluent. The elytra cover the abdomen, which has five visible sternites. The claws are simple or toothed, tooth never over one-half the length of the claw.

Relationship of the Genera

The most primitive of the genera of Oedemerids seems to be the genus *Calopus*. The pronotum is nearly quadrate, being only slightly expanded apically. The eyes are deeply emarginate, with the antennae inserted within the emargination, a character which it shares with *Scraptia*. The antennae of the male are sub-serrate, or perhaps could be referred to as serrate. The distribution is spotty, occurring throughout the United States and Europe.

The Nacerdinae exhibit certain primitive characters, especially in the male

genitalia, and are certainly of early origin, being cosmopolitan in distribution. They are quite distinct from the Calopodinae, and seem to be removed from the Oedemerinae both on genitalia and external morphology. The presence of only one apical fore tibial spur is basic and offers a character which is unfailing in all of the species.

The subfamily Oedemerinae may be called the most derivative of the generic groups. The limits between the genera offered the greatest problem in this study, and although I feel that they are more or less satisfactorily worked out for the Nearctic members, there remains much to be studied before a comprehensive understanding of the genera is attained.

The tribe Ditylini has the one genus *Ditylus* which is very distinctive in gross appearance. All of the species are large, and black in color. They look quite different from the other members of the family, yet they offer little in external morphology to separate them. The real distinctive characters are in the structure of the male genitalia. The ninth abdominal sternite consists of two divergent rods and the tergite two parallel chitinous rods broadly united by membrane. This combination of characters is not found elsewhere in the family.

The remainder of the Nearctic genera are placed in the tribe Asclerini. The most primitive of these genera, *Heliocis*, *Eumecomera*, and *Sisenes* show a strong resemblance to the Ditylini in the structure of the male genitalia, but in no other way. They are medium sized and resemble the other genera of Asclerini in gross appearance. The more derived genera, *Oxacis*, *Alloxacis*, *Copidita*, *Asclera* and *Rhinoplatia* are all closely related, but may be clearly defined on both genitalia and external character.

It was necessary to make a number of changes in the Asclerini in order to define these genera. The genus *Copidita* as defined by Horn in his 1896 work was found to be a hetergenous assembly of species. It was discovered that only *Probosca quadrimaculata* Mots. could remain in the genus as defined by LeConte. *Ditylus bicolor* Horn, *Ditylus cyanipennis* Horn and *Asclera obscura* LeC. form a distinct genus, *Eumecomera*, which is here described. The remaining species associated with *P. quadrimaculata* Mots. are removed and placed with *Oxacis cana* LeC., but kept as a distinct subgenus, *Oxycopis*, here described. The genus *Sisenes* Champ. was placed in the subfamily Oedemerinae by Seidlitz, 1899, but really belongs as a primitive Asclerini, as pointed out above. It was also necessary to remove *Chrysanthia repanda* Horn from the genus *Chrysanthia* Schmidt because of distinct differences from the genotype, *C. viridissima* (L.), and place it in a new genus, *Heliocis*, here described. The genus *Oxacis* LeC. now becomes the largest genus in the Nearctic Region, and for reasons discussed in that section of this paper it is divided into four subgenera, each of which is readily definable. With these changes then, I believe that the Nearctic species fit into distinct generic groups, avoiding the former difficulties in defining these genera.

KEY TO THE SUBFAMILIES OF THE NEARCTIC OEDEMERIDAE

1. Antennae situated in deep emargination of the eyes; male with a central basal apodeme on the eighth abdominal sternite ..... Calopodinae

Antennae situated in front of the eyes which may be emarginate or not; male lacking a basal apodeme on the eighth abdominal sternite 2

2. Front tibia with a single apical spur; eighth abdominal sternite of male with apical lobes scoop-shaped, large and prominent ..... Nacerdinae

Front tibia with two apical spurs; eighth abdominal sternite of male never with large and prominent scoop-shaped lobes ..... Oedemerinae

CALOPODINAE Costa

Calopini Costa, Fauna Regni Napoli, Edemer., p. 4, 1852.

This subfamily contains eighteen species in four genera, (*Calopus* Fab. 1775, *Sparedrus* Latr. 1829, *Sparedropsis* Hayd., 1886, and *Ocularium* Pic, 1922), distributed throughout the Holarctic Region and extending into the Neotropical Region in Central America, and into the Oriental Region in Tonkin. Two species and two genera occur in North America. All members of this subfamily are poorly known, thought to be rare, and seem to be the primitive members of the family. They are found distributed only as "puddles" throughout the Northern Hemisphere.

They are at once recognized by the deep emargination of the eye and by the peculiar insertion of the antennae within this emargination. Grossly they resemble certain Cerambycids, particularly because of their long antennae and slim bodies. They are of moderate size.

The male genitalia are singular in the presence of a central basal apodeme on the eighth abdominal sternite. They show a strong resemblance to the Nacerdinae, to which this subfamily is perhaps closely related, and in some respects to the tribe Ditylini.

This subfamily contains the two genera, *Calopus* Fab. and *Sparedrus* Latr. from the Nearctic Region.

KEY TO THE GENERA

Mandibles bifid; basal central apodeme of the eighth abdominal sternite of the male short, not projecting beyond the base ..... *Calopus* Fab.

Mandibles entire; basal central apodeme of the eighth abdominal sternite of the male long, projecting beyond the base ..... *Sparedrus* Fab.

CALOPUS Fabricius

Calopus Fabricius, Syst. Ent., p. 182, 1775.—LeConte, Classif. Col. N. Amer., p. 258, 1862.—LeC. & Horn, Classif. Col. N. Amer., ed. 2, p. 404, 1883.—Champ., Biol. Centr.-Amer., Col. IV, 2, p. 110, 1889.—Semen., Horae Soc. Ent. Ross., 28: 451, 1894. —Horn, Proc. Calif. Acad. Sc., (2), 6: 384, 1896.—Seidlitz., Naturgesch. Ins. Deutschl., V, 2: 731, 1899.

Genotype: Cerambyx serraticornis L., 1758, [Designated by Latreille 1810: 430.]

The genus *Sparedrus* Latr. is the closest relative of this genus; both genera show a certain affinity with the genera *Xanthochroa* Schmidt, *Nacerdes* Dejean and *Ditylus* Fisch-Waldh., particularly in the male genitalia. The present genus is distinguished readily from the other genera by the bifid mandibles, the large size, and the long antennae which are flattened and subserrate in the male. The basal central apodeme of the eighth sternite of the male is short, not projecting beyond the base which is unlike the situation in *Sparedrus*.

This genus contains rather large species which average about 18 mm. in length. The genotype resembles the following North American species superficially except for details of sculpture and vestiture. The male genitalia of the two are quite distinct.

Generic features.—Form slender. Head short. Eyes deeply emarginate, embracing the base of the antennae. Mandibles bifid at the apex. Antennae subserrate, inserted upon slight protuberances, eleven jointed. Thorax quadrate, nearly as broad basally as apically. Legs long, slender; tibiae with two apical spurs; tarsi with penultimate and antepenultimate segments bilobed. Fore and middle tarsi with segments 2-4 spongy beneath; hind with 2 and 3 spongy beneath. Abdomen of five visible segments in both sexes.

Male genitalia.—The median lobe is long and slender without basal processes, straight. The paramere is a smooth trough, without apical lobes, but with basal processes which are linear and curved, embracing the median lobe. The tegminite is a simple plate, somewhat trough-like, membranous at the base, chitinous at the apex. The ninth segment has a small tergite which is stirrup- or heart-shaped and is connected by membrane to the sternite. The sternite consists of two long rods lying paralled to each other; each is enlarged apically. A membrane connects the two ventrally at the apical third and for a very short distance basally. The eighth segment has the tergite a simple lobe which is hairy at the apex. The sternite is emarginate at the apex, hairy; basally it is emarginate with a central apodeme which does not extend to the base. The two are connected at the base, but hinged by membrane.

Distribution.—There are three species, two of which are confined to the Palearctic Region, and one, *C. angustus* LeC., which is Nearctic.

CALOPUS ANGUSTUS LeConte

Calopus angustus LeConte, Ann. Lyc. Nat. Hist. N. Y., 5: 158, 1851.—LeC., New Species Col. I, p. 163, 1866.—Horn, Proc. Calif. Acad. Sc. (2), 6: 385, 1896.—Seidl., Naturgesch. Ins. Deutchl., V, 2: 735, 1899.

The larger size, the fuscous color, the long antennae and the resemblance to a Cerambycid readily differentiate this species from the other members of this family.

Lectotype: ♀, New Mexico, [MCZ (LeC.) type no. 4786 (marked with a green disc)].

Head short, deeply, coarsely and closely punctate; gula rugose. Antennae eleven-segmented, second segment short, remainder elongate, somewhat flattened. Each segment is four times as long as width at middle. Eyes deeply emarginate, large, subcircular, antennae inserted within the emargination so that the eyes are beyond the base of the antennae. A smooth canthus extends within the emargination. Mandibles both bifid at the apex, very short, less than one-third the length of the head, blunt. Maxillary palpi with the apical segment triangular, widest near the center.

Notum of thorax rugose-punctate, constricted at center, no wider apically than basally, as long as broad; rugose at base of coxae. Sternum more

sparsely and finely punctate than the notum. Legs slender; claws quadrately expanded at base.

Elytra elongate, arcuate at apex and acute, coarsely punctate.

Abdomen punctate and rugose; apical segment evenly rounded.

Color fusco-testaceous; the entire body is covered with sparse, long coarse white pubescence.

Length: 18 mm.

Male.—Fallen L[eaf] Lake, Eldorado Co., California, alt. 6,300 ft., June 12, 1930, (A. T. McClay), [McClay].

Differs from type in the following ways: the apical segment of the abdomen is deeply emarginate; the eyes are nearly contiguous; the segments of the antennae are expanded, flattened, except the apical segment (eleventh), long, extending beyond the apex of the elytra.

Male genitalia.—(Pl. II, fig. 6). Large; the median lobe long, about 5 mm., straight, apex with slight ventrally projecting hook; oriface ventral and traversing nearly the entire length of median lobe, base of lobe blunt, without projecting processes.

Paramere a trough, evenly arcuate at apex, base with two slender, dorsal sinuate spurs which clasp about the median lobe. Tegminite a simple broad lobe with a membranous base and an arcuate apex which is clothed with hair.

Ninth segment: tergite small, linear, expanded at apex and deeply emarginate, stirrup- or elongate heart-shaped, attached to sternite by membrane which forms a tube. Sternite consists of two long rods lying parallel to each other; each enlarged apically with a recurved hook about one-fourth distance from apex; a membrane connects the two ventrally at the apical third and for a very short distance basally.

Eighth segment: tergite a simple lobe, arcuate at the apex and emarginate at the base, membranous at center except for apical third; hairy at apex. Sternite deeply emarginate at apex, hairy, basally emarginate with a central apodeme which does not extend to the base. The two are connected at the base, but hinged by membrane.

Individual variation.—Slight, except in size, which is not sexual, and in details of sculpture and shape of the pronotum. The size varies from 15-21 mm. in the specimens examined. The sculpture varies from nearly distinctly punctate to nearly rugose, the majority being rugose-punctate. The notum is normally quadrate, scarcely broadened anteriorly varying to distinctly broadened anteriorly.

Biology.—All that is known of the biology is the note in Mr. Procter's book that the Mount Desert specimen(s?) was collected under Cedar bark.

Distribution.—This species has been found to occur in the west as far north as Terrace, B. C., south through California and east to the edge of the Rocky Mountains in Alberta, Idaho, Colorado, and New Mexico. Horn also records it from Texas. There is a specimen in the Chicago Museum of Natural History collection from Pennsylvania. LeConte records it from Quebec

and there are specimens in the Horn collection and also in the LeConte collection labeled "Can." Mr. Procter's Mount Desert Survey records this species from that region in Maine. This represents some ten specimens from the east. I have seen all of these except the Mount Desert specimen(s?) and know them to be correctly identified.

Specimens examined.—39: 13 ♂ and 26 ♀.

BRITISH COLUMBIA: Terrace, (Mrs. Hypicley): 1 ♂, 1 ♀; Golden, March, 1907, (F. Blanchard): 1 ♀; Vancouver: 1 ♀, [MCZ].

ALBERTA: Banff, July 6-9, 1902, (Fall?): 1 ♀, [MCZ].

WASHINGTON: Puyallup, alt. 49 ft., April 18, 1931, (Arthur J. Hanson): 1 ♀; July 3, 1928: 1 ♂; Mt. Rainier, Paradise Valley, July 15, 1938, (A. T. McClay): 1 ♂, [McClay]. *No further data:* 1 ♀, [ANSP (Horn)].

OREGON: Mount Hood, (Robin Hood, F. C.), July 2, 1941: 1 ♀, [Fender]. Mescham, May 22, 1935, (H. P. Lanchester): 1 ♀, [AMNH].

IDAHO: Wallace, June 20, 1935: 1 ♀, [RPM]. Moscow Mt., alt., 3,000 ft., April 9, 1940, (S. Lienk): 1 ♀; Moscow, April 11, 1932, (T. A. Lindley): 1 ♂; alt. 2,560 ft., April 12, 1930, (C. Wakeland): 1 ♂, 1 ♀; April 5, 1930, (C. Wakeland): 1 ♀, alt. 3,200 ft., April 17, 1929, (W. E. Shull): 1 ♂; April 25, 1932, (T. A. Brindley): 1 ♂; Boise, alt. 2,692 ft., April 23, 1933, (R. E. Miller): 1 ♀, [Idaho].

CALIFORNIA: Fallen L[eaf] Lake, Eldorado Co., alt. 6,300 ft., June 12, 1930, (A. T. McClay): 1 ♂; McLoud, July 1914: 1 ♀, [McClay]. *No further data:* 1 ♀, [ANSP].

NEVADA: *No further data:* 2 ♀, [ANSP].

NEW MEXICO: *No further data:* 2 ♀, [ANSP].

COLORADO: Douglas Co., April 12, 1914, (Champlain): 2 ♂, [MCZ].

CANADA: no further data: 2 ♂, 3 ♀, (published as "Quebec"), [MCZ (LeC.)]: 1 ♂, [ANSP (Horn)].

PENNSYLVANIA: Tioga Co., 1 ♀, [CNHM (Psota Coll. ex J. C. Warren Coll.)]. Harrison Valley: 1 ♀, [USNM].

SPAREDRUS Latreille

Sparedrus Latr., Régné Anim., ed. 2, p. 48, 1829.—Horn, Proc. Calif. Acad. Sc., (2) 6: 386, 1896.—Seidlitz., Naturgesch. Ins. Deutschl., V, 2: 742, 1899.
Genotype: Calopus testaceus Andersch, 1797 [Monobasic.]

The following species was included in this genus by Dr. Horn in his monograph (1896) of this family. It was retained in this genus by Schenkling in his catalogue (1915). I have been unable to examine any specimens of the genotype, so this placing is still of a tentative nature, although there is little doubt but that it is correctly placed.

The Nearctic specimens may be separated from the foregoing species by the entire mandibles, the smaller size, and shorter antennae, each segment of which is rounded. The male genitalia are unique in that the long central basal apodeme on the eighth sternite projects well beyond the base.

Generic features.—Form slender; head short; eyes deeply emarginate, embracing the base of the antennae. Mandibles simple. Antennae subserrate, inserted upon slight protuberances, eleven jointed. Thorax slightly longer than broad, slightly expanded apically, sides sinuate. Legs long, slender; tibiae with two apical spurs; tarsi with penultimate and antepenultimate segments expanded, only slightly emarginate apically, both spongy beneath.

Elytra elongate, acute at the apex and covering the abdomen. Abdomen of five visible segments in both sexes.

Male genitalia.—Median lobe long, straight, without basal processes; paramere with a membranous apex, base expanded; tegminite a simple lobe; ninth tergite elongate heart-shaped, attached to the sternite by membrane; ninth sternite consisting of two parallel rods united by membrane, apically expanding with a membranous apical lobe; eighth sternite basally with a long central apodeme which extends beyond the base, emarginate at apex; eighth tergite a simple broad lobe deeply emarginate at the base, connected to the tergite by membrane.

Distribution.—This genus contains seven species, one Nearctic, four Neotropical and two Palearctic. The following species, *S. aspersus* LeC., is known only from the Nearctic Region and is confined to the southwest.

SPAREDRUS ASPERSUS (LeConte)

Calopus aspersus LeC., New Species Coleo., 1: 163, 1866.—Horn, Proc. Calif. Acad. Sc., (2) 6: 386, 1896.—Seidlitz, Naturgesch. Ins. Deutschl., V, 2: 735, 1899.

The mottled appearance of the elytra, the smaller size and the resemblance to a Cerambycid readily distinguishes this species from other members of this family.

Lectotype: ♂, Texas, [MCZ (LeC.), type no. 4787, (red disc)].

Form slender. Head short, coarsely and closely punctate, punctures broad and moderately deep; gula bare, vaguely rugose. Antennae eleven-segmented, second segment very short; each segment elongate, five times as long as wide, slightly expanded apically, not markedly flattened, longer than the body, inserted within the emargination of the eyes. Eyes subcircular, large, deeply emarginate, nearly contiguous dorsally, a rugose canthus extending from the base of the antennae onto the head; eyes extending nearly twice the width of the base of the antennae beyond the antennal base. Mandibles simple, not bifid at the apex. Maxillary palpi four-segmented, apical segment broad, triangular, widest at the middle.

Thorax: notum rugose or irregularly punctate; slightly longer than broad, very slightly expanded apically, sides slightly sinuate; smooth at the base of the coxae in a small area only; sternum rugose; legs slender, tibiae with two apical spurs; claws simple, quadrately expanded at the base.

Elytra elongate, arcuate at apex and acute, irregularly punctate.

Abdomen rugose; five visible sternites, apical sternite emarginate.

The entire body is covered uniformly with moderately long, moderately dense, rather fine, golden pubescence. Color: entirely fusco-testaceous.

Length: 10 mm.

Female.—Lower California, [MCZ (LeC.), silver disc with edge cut].

Agrees with the male except that the apical sternite of the abdomen is evenly arcuate; eyes not so close together; elytra with slight protuberances which are devoid of pubescence giving a blotchy appearance; apical segment of the maxillary palpi widest apically.

Male genitalia.—(Pl. II, fig. 7.). Median lobe long, straight, slightly expanded apically, but not recurved; orifice about one-fourth the distance from the apex, ventral, small, not over one-eighth the entire length, base slightly curved dorsally, but without processes; paramere trough-like with base greatly expanded dorsally so that it nearly surrounds the median lobe, apex somewhat expanded with a membranous dorsal pad which is hairy; tegminite a simple straight lobe somewhat expanded apically, curved making a slight trough, apex hairy; ninth tergite heart shaped, elongate, emarginate at the apex and slightly furcate at base, connected to the sternite by membrane which forms a tube; sternite consists of two parallel, slightly sinuous rods which diverge apically and have apical enlargements projecting dorsally which are connected by membrane to the tergite; ventrally the two rods are connected for their entire length by membrane except for a narrow slot at the center which runs apically to slightly beyond the center, apically there is a membranous lobe which is arcuate; eighth sternite with a long central, basal apodeme which extends well beyond the base, base deeply emarginate, apex slightly emarginate, setae present along the apical end; eighth tergite a simple arcuate lobe very slightly emarginate at the apex and deeply emarginate at the base, the area within the emargination connected by membrane which merges into the more chitinous part, setae present at the apex.

Individual variation.—Slight except in size, which is not sexual, and in details of sculpture and shape of the pronotum. The size varies from 9-15 mm. with 11 being the average for specimens examined. The sculpture varies in that the elytra of some specimens which show a mottled appearance have slight protuberances which are devoid of pubescence, and the punctation varies from definite round depressions to more indefinite elongate depressions or rugose punctate. It is possible that there are two species involved here, the type on the one hand lacking elytra protuberances and the allotype having them, which goes with the shape of the apical segment of the maxillary palpi, which is widest at the middle in the type and widest apically in the allotype. It does not seem to be sexual, because even though all of the specimens examined which had the elytra protuberances were females, there were also females without the elytra protuberances. Until more specimens are examined or until males are found with elytra protuberances, it is best to call this one species.

Biology.—Nothing is known of the biology of this species.

Distribution.—This species is recorded from Texas and Lower California only. All of the specimens examined are old and without precise locality data. No recent collections seem to have been made. It apparently is extremely rare.

Specimens examined.—24: 6 ♂ and 18 ♀.

TEXAS: S[outh] W[est]: 2 ♂; *no further data:* 2 ♂, 3 ♂; [ANSP (Horn)] 1 ♂ (type); [MCZ LeC.)]: 3 ♀; [MCZ]: 1 ♀; [ANSP]; (F. W. Bowditch): 2 ♀; 2 ♀; [MCZ]; 1 ♀: [CNHM]; 1 ♂; [USNM].

LOWER CALIFORNIA: 1 ♀, [MCZ (LeC.) Allotype].

NO DATA: 1 ♀: (Horn); [ANSP].

NACERDINAE Semenow

Nacerdinae Semen., Horae Soc. Ent. Ross, 28: 450, 1894.

The old tribe *Nacerdini* is sufficiently distinct from the other members of this family to give it subfamily rank. This is evident both by the structure of the fore tibiae and by the structure of the male genitalia.

As here recognized, this subfamily contains the following genera: *Xanthochroa* Schmidt 1846, *Zabriola* Fairm. 1901, *Dityloidea* Fairm. & Germain. 1863, *Nacerdes* Dej. 1834, *Allagatha* Semen. & Ninae 1937, *Micronacerdes* Pic 1923, *Nacerdoscuta* Pic 1915, and *Milneum* Pic 1923. The genus *Mimonocomera* Pic 1923 is tentatively placed in this subfamily, but unlike the other genera this lacks even a single apical spur on the fore tibia. This represents about 108 species distributed throughout the world, the majority of which (92) belong in the genera *Xanthochroa* Sch. and *Nacerdes* Dej.

The genera *Xanthochroa* Sch. and *Nacerdes* Dej. are represented in the Nearctic Region. The presence of a single apical spur on the fore tibia readily identifies members of this subfamily in this region. The eyes are emarginate with a smooth canthus within the emargination. These are moderate size to small insects.

The male genitalia have the median lobe long and straight without basal processes; the ninth sternite consists of two long divergent rods variously modified, and the eighth sternite is produced into two large, prominent, scoop-shaped lobes.

KEY TO THE GENERA

Eyes large, front between the eyes narrower than the eyes; eyes moderately deeply emarginate; male with ninth sternite apices at most bifurcate; ninth tergite without median-ventral suture ..... *Xanthochroa* Sch.

Eyes small, front between eyes broader than the eyes; eyes scarcely emarginate; male with ninth sternite apices trifurcate; ninth tergite with median-ventral suture ..... *Nacerdes* Dej.

XANTHOCHROA Schmidt

Xanthochroa Schmidt, Linn. Ent. I: 35, 1846.—Lacord., Gen. Col., 5: 705, 1859.—LeC., Classif. Col. N. Amer., 405, 1863.—LeC. & Horn, Classif. Col. N. Amer. ed 2: 405, 1883.—Semen., Horae Soc. Ent. Ross., 28: 452, 1894.—Horn, Proc. Calif. Acad. Sc. (2), 6: 391, 1896.—Seidlitz., Naturgesch. Ins. Deutschl., (V), 2: 749, 1899.

Genotype: Oedemera carniolica Gistl, [Designated by Arnett, 1950, p. 225].

Lacordaire mentions in his characterization of the genus that all of the tarsal segments are tomentose below except the last. He also mentions a long snout. Horn refers to these statements in his monograph and wonders if the North American species should be included in this genus. But Lacordaire also mentions a South American representative that he has in his collection. Perhaps he was looking at it when he mentioned the above tarsal characters and the long snout because these characters fit *Dityloidea*, which is a monotypic genus from Chile. None of the other species included in this genus seem to have these characters mentioned by Lacordaire. I have seen the genotype of this genus, and our Nearctic species fit here.

This genus is closely related to the following, *Nacerdes* Dej., and is

separated from the latter by the large and more deeply emarginate eyes, and by the male having the ninth sternite apices at most bifurcate, and the ninth tergite without a median-ventral suture.

The species are of small to moderate size, varying from about 8 mm. to 14 mm. in length. They are all of slender form and similar in appearance. The species are quite distinct morphologically; the color patterns which are rather constant in this genus, and the male genitalia serve best for keying. The color differences are substantiated by details of vestiture and punctation.

Generic features.—Form slender. Head of moderate length, not produced. Antennae inserted between the eyes and the base of the mandibles; eleven-segmented in the female, apparently twelve-segmented in the male, This genus is closely related to the following, *Nacerdes* Dej., and is the false twelfth segment and the false eleventh segment together as long as the tenth. The eleventh segment of the female also falsely ringed, but rarely as distincly as the male. Each segment of the antennae elongate, linear, not subserrate. The mandibles are both bifid. The maxillary palpi are four-segmented; the apical segment is elongate-triangular, usually with a slight emargination near the apex on the outer or longest side of the triangle. Legs slender; fore tibia with a single apical spur in both sexes; penultimate tarsal joint alone spongy beneath; claws simple, at most somewhat quadrately enlarged at the base. The elytra are elongate, vaguely costate, the apex arcuate and acute. The apical visible sternite of the abdomen of the male is very deeply emarginate, forming two distinct lobes; that of the female evenly arcuate.

Male genitalia.—The median lobe is straight, without basal processes, but with a distinct apical hook or hooks which project ventrally; oriface ventral, extending nearly the entire length of the lobe. The paramere and tegminite are both simple troughs, which are arcuate at the apex and truncate at the base; the latter is not heavily chitinized. The ninth tergite is large, more or less fan-shaped without a vertical median suture. The ninth sternite consists of two diverging rods, united ventrally by membrane and apically enlarged. The eighth sternite is lobed apically, each lobe scoop-shaped, with a lateral narrow suture which is separated and connected by membrane. The eighth sternite is a simple plate with two apical lobes, membranous at base.

Distribution.—The members of this genus are confined to the Holarctic Region and in the Nearctic Region they are confined either to the southeastern section of the United States, or the Pacific coast.

KEY TO THE SPECIES

1. Head, thorax and appendages uniformly testaceous; elytra fusco-testaceous ..... *testacea* Horn
   Elytra dark; head, thorax and appendages variously colored 2
2. Head black; mandibles and front orange 3
   Head orange, with or without black markings 4
3. Thorax with a central black spot; elytra black ..... *centralis* Horn
   Thorax immaculate; elytra somewhat metallic blue-green ..... *marina* Horn
4. Elytra metallic blue-green; head, thorax and femora orange; head sparsely and barely punctate ..... *californica* Horn

Elytra black with or without testaceous markings; head and thorax variously marked .. 5
5. Elytra with testaceous sutural markings; thorax orange with black markings 6
Elytra without testaceous sutural markings; thorax black with central orange stripe .....*erythrocephala* (Germ.)
6. Large species; thorax with central black stripe and each side with large black spots; front with two black spots or rarely with a median stripe or nearly immaculate .....*trinotata* LeC.
Size normal; thorax with lateral spots only; head immaculate .....*lateralis* (Mels.)

KEY TO THE MALES

The male of *X. trinotata* LeC. is unknown.
1. Semi-chitinous lobes extending from the apical juncture of the ninth sternite, ninth tergite, and eighth tergite, (juncture point), which project to or beyond the apex of the tergite .....*erythrocephala* (Germ.)
Such a lobe not present, or much smaller and not inserted at the above mentioned juncture point 2
2. A small, semi-chitinous lobe present along each lateral margin of the ninth tergite; median lobe with the apical hooks situated basally a distance equal to one-half the width of the apex .....*testacea* Horn
Without such a lobe as mentioned above; apical hook situated basally a distance equal to at least the width of the apex 3
3. Apex of the ninth tergite with a small, external knob, lateral to and sub-basal to expanded flange; apical hook of the median lobe projecting beyond the lateral surface of the median lobe .....*centralis* Horn
Apex of the ninth tergite with an expanded flange only 4
4. Apical hook of the median lobe large, forming a transverse, recurved, but straight blade which projects beyond the lateral surface .....*marina* Horn
Apical hook of the median lobe small, not projecting beyond the lateral surface of the median lobe .....*californica* Horn

XANTHOCHROA TRINOTATA LeConte

Xanthochroa trinotata LeConte, New Species Col., 1: 164, 1866.—Horn, Proc. Calif. Acad. Sc., (2), 6: 392, 1896.

The large size, the thorax with a central black stripe and each side with large black spots, and the maculate front, are all characters which separate this species from the other Nearctic members of the genus.

Holotype: ♀, Louisiana, [MCZ (LeC.), type no. 4794].

Head of moderate length, coarsely, moderately densely, deeply and regularly punctate; gula bare. Antennae eleven-segmented, apical segment not noticeably ringed, segments three to ten elongate, four times as long as width at center. Eyes moderate in size, elongate oval, moderately deeply emarginate, set some distance from the antennae. Mandibles both bifid at the apex. Maxillary palpi with the apical segment slender, widest beyond the center.

Notum of thorax longer than broad, widest towards apex, sides sinuate, surface coarsely, shallowly, irregularly punctate, smooth at the base of the coxae. Sternum of the thorax rugose. Legs slender, claws simple with slight enlargement at the base. The elytra are moderately costate, rugose.

The abdomen is rugose, the apical sternite subacute at the apex.

Pubescence: head with long, moderately sparse, fine, yellowish hairs. Thorax and legs with moderately long, rather dense, erect, moderately fine

yellowish-white hairs. Elytra and abdomen with dense, coarse, moderately long white hairs.

Color: in general piceous with orange markings; head orange-yellow with piceous spot on the front and between the eyes; antennae piceous; thorax orange wtih a median piceous stripe and two lateral stripes; legs piceous, pale at the knees; elytra piceous with pale, narrow sutural stripe and slightly broader pale lateral stripe; abdomen piceous.

Size: 14 mm.

Male unknown.

Individual variation.—Unknown.

Biology.—Unknown.

Distribution.—Known only from Louisiana and Alabama. Seems to be extremely rare.

Specimens examined.—4 ♀.

LOUISIANA: *No further data:* 1 ♀, (type), [MCZ]; 2 ♀, [ANSP (Horn)].

ALABAMA: Spring Hill, May 17, 1912, (H. P. Löding): 1 ♀, [Alab.].

Xanthochroa erythrocephala (Germar) new combination

Oedemera erythrocephala Germar, Insectorum species novae, Halae, p. 167, 1824.—Horn, Proc. Calif. Acad. Sc., (2), 6: 406, 1896, (*Asclera*).

Type Locality: Kentucky.

Nacerdes lateralis Melsheimer, Proc. Acad. Nat. Sc. Philad., 3: 54, 1846.—Haldemann, Journ. Acad. Nat. Sc. Philad., (2), 1: 96, 1848.— Horn, Proc. Calif. Acad. Ss., (2), 6: 393, 1896.

Type Locality: Pennsylvania.

Asclera signaticollis Haldemann, Journ. Acad. Nat. Sc. Philad., (2), 1: 96, 1848, [(MCZ type no. 8384)].—Horn, Proc. Calif. Acad. Sc., (2), 6: 393, 1896, [cited as a synonym of *Asclera lateralis* Melsheimer.]

Type Locality: Georgia.

The piceous-purple elytra, with or without lateral and marginal fuscous stripes, the orange head with or without a black front, and the black lateral stripes on the notum distinguish this species. The fore tibia have only one apical spur, the claws are simple and both mandibles are bifid. These last characters have been overlooked by Horn and other determiners, and for that reason are here emphasized.

Male.—Crescent City, Fla., March 27, 1896, (H. Hubbard), [USNM].

Head: moderately elongate, surface rugose-punctate; antennae appearing twelve-segmented, each segment five times as long as wide; eyes large, oval, moderately deeply emarginate; mandibles both bifid at the apex; maxillary palpi slender, apical segment widest near apex.

Thorax: notum longer than broad, rugose-punctate; sternum rugose; legs slender, claws quadrately enlarged at the base; elytra costate, rugose.

Abdomen: finely rugose, apical sternites deeply cleft forming two flaps.

Pubescence: head with moderately long, moderately dense recumbent golden hairs; thorax with hairs shorter, denser, erect, golden; elytra, venter, and legs with moderately long, dense, recumbent, golden pubescence.

Color: piceous-purple with testaceous markings. Head testaceous with

two large, lateral, piceous spots; legs fusco-testaceous; elytra entirely piceous-purple; abdomen piceous.

Length: 8 mm.

Male genitalia.—(Pl. III, fig. 10). Moderate size. Median lobe long, linear with a slight apical enlargement and two sub-apical recurved hooks situated basally a distance of about three times the width of the apical enlargement. Paramere simple, trough-like, arcuate at the apex and truncate at the base. Tegminite a semi-chitinous lobe somewhat acute at the apex, membranous and indefinite at the base with a slight central constriction. Ninth abdominal tergite fan-shaped, broadly arcuate at the apex, base narrow with two short acute projections which are joined with chitin. Sternite consisting of two rods, contiguous at the base, divergent apically, the apex furcate, one tip a blunt recurved joint, somewhat enlarged and recurved and joined to the lateral margin of the tergite at which point projects a large, membranous lobe, the apex of which is enlarged and setigerous; the other tip is blade-like and forms a recurved hook. Eighth abdominal tergite consists of two lobes, narrow at the apex and connected laterally by membrane; sternite of two large lobes, apical half of the lobes scoop-shaped, the lateral margins of which have a curved suture which is connected by membrane, the lobes connected by membrane with a small chitinous area at the center which bears small setae.

Female.—same data as male.

The female differs from the male only in that the antennae are clearly eleven-segmented, the apical segment is only slightly ringed; the apical sternite of the abdomen is triangularly emarginate.

Length: 11 mm.

Individual variation.—The punctation of the head varies from shallow, broad, irregular punctures to rugose-punctate. The color varies in the following respects: Head entirely orange, darkening to front and mouthparts piceous; elytra entirely piceous-purple in typical forms, varying to margins and suture fuscous, center with a fuscous stripe and ground color piceous.

Synonymical notes.—Although the type of *X. erythrocephala* Germar has not been seen, I have concluded from the identified material in both the LeConte collection and the Horn collection that the specimens called "Asclera erythrocephala Germar" in these collections are the same as that of Germar. In fact, LeConte moved his specimens and placed them with his material of Xanthochroa, but did not change the label from "Asclera." From this, then, I have concluded that this species should be placed in the genus *Xanthochroa* both on the basis of the single apical spur on the fore tibiae and the structure of the male genitalia, characters with which the LeConte and Horn specimens agree. In addition, specimens in other collections are thus labeled. If it should later prove that *A. erythrocephala* of authors is not the same as the Germar type, then the Melsheimer name, *X. lateralis* will be available for *X. erythrocephala* of authors.

The type of *X. signaticollis* Haldemann, which is in the collection of the

Museum of Comparative Zoology agrees with the material labeled *X. lateralis* Melsheimer, in the LeConte collection. The type of *X. lateralis* Mels. is unknown, but undoubtedly the material in the LeConte collection includes the type series. I can find no morphological difference between the type of *X. signaticollis* and the *X. lateralis* series. I have therefore placed *X. signaticollis* as a synonym of *X. lateralis* Melsheimer.

After examining a long series of *X. erythrocephala* Germar, I have concluded that *X. signaticollis* Haldemann and *X. lateralis* Melsheimer are conspecific with *X. erythrocephala*. I have been unable to find any morphological differences either in the male genitalia or in the external structure of these series. There are color differences, but with many intergrades. They occupy the same range. The Germar name was the first proposed, and therefore must be used for this species.

Biology.—Adults collected on *Cornus amomum*.

Distribution.—This species is found as far south as Enterprise, Florida, (northern half), north to Virginia and southern Maryland, and west to Louisiana, with one record from Kansas.

Specimens examined.—99: 39 ♂, 51 ♀, 12 sex undetermined.

LOUISIANA: Winnfield, June 2, 1918: 1; no further data: 1 ♂, [MCZ (LeC.)].

KANSAS: *No further data:* 1 ♂, [ANSP].

MISSISSIPPI: Lucedale, May 17, 1931, 6 ♂, 1 ♀, 1; Perkiston, May 14, 1930, 1 ♂; Leakesville, May 8, 1931, 2 ♂, 1 ♀, (H. Dietrich), [CU]. Grenada, June 15, 1938, (H. Dybas), 1, [CMNH]. *No further data:* 1, [NCZ (LeC.)].

ALABAMA: Spring Hill, June 11, 1918, (Th. Van Aller): 1; May 21, 1919, (H. P. Löding): 1, [MCZ]. Spring Hill, May 16, 1919: 1 ♀; May 20, 1917: 3 ♀; May 14, 1921: 3 ♀; May 12, 1911: 1 ; May 14, 1921: 1; May 25, 1919: 2 ♀; May 21, 1919: 2 ♀, 1; June 2, 1923: 1 ♀; May 13, 1911: 1 ♀; May 1, 1922: 1 ♀; Mobile, May 20, 1923: 2 ♂, 1; June 7, 1921, (H. P. Löding): 1 ♂, 1 ♀; Magazine Pt., April 21, 1909: 1 ♀; Orchard, May 7, 1922: 1 ♀; May 6, 1911: 1 ♂, (H. P. Löding); Spring Hill, April 19: 1 ♀; May 29: 2 ♀; May 11: 1 ♂, 1 ♀, (Th. Van Aller); Whistler, May 3, 1914: 4 ♀, 3 ♂; Springhill, May 27, 1923: 2 ♀, 1 ♂; [Alab.].

GEORGIA: *No further data:* 3 ♀ (Horn); 1 ♀, [ANSP]; 2 ♂, 2 ♀ [MCZ].

FLORIDA: Enterprise: 1 ♀, [MCZ (LeC.)]; 5 ♀, [RPM]; Crescent City, March 27, 1896, (M. Hubbard); 2 ♂, 1 ♀; Apr. 1908 (Van Duzee): (Wickhan Co.): [USNM]; Jacksonville: 1 ♂, 2 ♀, [RPM].

SOUTH CAROLINA: Florence, May 18, 1930; 1 ♀; St. Stephens, May 24, 1934, (O. L. Cartwright): 1 ♀, [USNM].

NORTH CAROLINA: *No further data:* 4 ♂, 1 ♀, [ANSP (Horn)]; 1 ♀ [MCZ LeC.)].

VIRGINIA: Nelson Co., June 28, 1920, (W. Robinson): 1 ♂, [USNM].

MARYLAND: Beach of Potomac River nr. Nanjemoy, (G. B. Vogt): 2 ♂, 3 ♀, [Author].

SOUTHERN STATES: *No further data:* 2 ♂, (1 marked type no. 8384 [*signaticollis*]) 2 ♀, [MCZ LeC.)].

NO DATA: 1 ♂, 1 ♀, 2. [ANSP (Horn)].

XANTHOCHROA TESTACEA Horn

Xanthochroa testacea Horn, Proc Calif. Acad. Sc., (2) 6: 395, 1896.

This species is most easily recognized by the uniform testaceous color.

Lectotypes: ♂, Washington; [ANSP (Horn)].

Head: of moderate length, surface sparsely punctate, shiny, gula smooth. Antenna apparently 12-segmented, the two apparent apical segments equal to the tenth in length, the others each four times as long as wide, slightly expanded apically. Eyes large, moderately deeply emarginate, well separated, antennae inserted contiguous with the eyes. Both mandibles bifid at the apex. Maxillary palpi four segmented, apical segment broadest near the apex.

Thorax: notum as long as wide, expanded apically, sides sinuate, surface punctate, punctures set well apart, small, shallow. Sternum slightly rugose. Legs slender, claws quadrately enlarged at base. Elytra rugose, strongly costate.

Abdomen sparsely punctate, shiny, with five visible sternites, apical sternite very deeply cleft forming two flaps.

Pubescence: head nearly bare, thorax and abdomen sparsely and elytra and legs moderately clothed in rather long, fine, whitish pubescence.

Color: pale testaceous; thorax with two lateral brownish spots; elytra with humera brown, extended as a narrow band nearly to the apex; abdomen piceous, apical segment testaceous.

Length: 12 mm.

Male genitalia.—(Pl. III, fig. 9). Median lobe long, slender, orifice traversing entire length except for short distance at base; small apical hooks present at the apex, recurved, base of hooks set basally a distance one-half the width of the apex. Paramere a short trough, arcuate at the apex, truncate at the base. Tegminite a semi-chitinous lobe, somewhat acute at the apex, membranous at the base. Ninth abdominal segment: tergite fan-shaped with small lateral lobes bearing setae; sternite composed of two apically divergent rods, bifurcate at the apex, one tip a dorsally projected blade-like flange which is recurved, the other blunt, recurved and joining the tergite laterally between the lateral lobes. Eighth abdominal segment: tergite two simple lobes united by a membrane; sternite similar to the preceding species. Setae present on lobes of the eighth sternite and the lateral lobes of the ninth tergite.

Allotype: ♀, Vancouver [ANSP (Horn)].

The female agrees with the male except that the eleventh segment of the antennae are scarcely ringed. The apical sternite of the abdomen is characteristically triangularly emarginate.

Length: 12 mm.

Individual variation.—There is very little variation in the specimens examined, even in the punctation which is quite variable in the preceding species. However, in this species there is some color variation. Some specimens examined have definite piceous stripes on the elytra, but these are not dark enough to change the overall color pattern which is pale testaceous.

Biology.—Unknown.

Distribution.—This is a west coast species found in Vancouver Island, Washington, Oregon and northern California.

Specimens examined.—34: 8 ♂, 25 ♀, 1 sex undetermined.

BRITISH COLUMBIA: Vancouver: 1 ♀, [MCZ (LeC.)], (incorrectly marked type); 2 ♀, [ANSP (Horn)], (marked paratypes).

WASHINGTON: Tacoma: 1 ♂, [ANSP]. Skye, June 2, 1936: 1 ♂, [Fender]. *No further data:* 1 ♀, [MCZ (LeC.)]; 1 ♂ (marked type no. 8050), 2 ♂, 3 ♀, [ANSP (Horn)]; 4 ♀ [ANSP].

OREGON: Portland, March 7, 1896, (N. C. F.): 1 ♂, [MCZ]. Dilly: 1 ♀, [AMNH]. North Santiam, Marion Co., July 15, 1946, (L. D. Townsend): 1 ♀, [Idaho]. McMinnville: 2 ♂, 1 ♀; August 8, 1940: 1 ♀; Bald Mt., Yambill Co., August 6, 1942 (K. M. & D. M. Fender): 5 ♀, [Fender]. *No further data:* 1, [MCZ LeC.)].

CALIFORNIA: Alameda Co., June 14, 1904, (F. W. Nunenmacher): 1 ♀, [CNHM]. Wilsonia, Tulane Co., August 8, 1945: 1 ♀ [Idaho]. Yosemite National Park, Aug. 1, 1940, (D. J. & J. N. Knull): 2 ♀, [OSU].

NO DATA: 1 ♀, [ANSP].

XANTHOCHROA CALIFORNICA Horn

Xanthochroa californica Horn, Trans. Amer. Ent. Soc., 5: 39, 1874.—Proc. Calif. Acad. Sc., (2), 6: 394, 1896.

The metallic-blue-green elytra, orange head, thorax and femera are constant characters for the separation of this species.

Lectotype: ♀, "Cala" [California, El Dorado Co.], [ANSP (Horn), type no. 8052].

Head: short, very sparsely punctate. Antennae eleven-segmented, eleventh barely ringed; each segment three and one-half times as long as broad; inserted near eyes. Eyes: large, oval, distinctly emarginate. Mandibles both bifid at the apex. Maxillary palpi with apical segment slender, broadest near the apex.

Thorax: notum as broad as long, widest apically, sides sinuate; surface shiny, feebly punctate. Sternum shiny, feebly rugose. Legs slender, claws simple. Elytra moderately rugose, not costate.

Abdomen: moderately rugose (less than the elytra and more than the head), apical sternite produced and slightly triangularly emarginate.

Pubescence: thorax and head with sparse, moderately long golden hairs; elytra with shorter, denser whitish hairs.

Color: blue-green metallic with piceous and orange-yellow markings; head orange-yellow; antennae piceous, basal segment yellow; thorax orange-yellow, sternum piceous; legs orange-yellow; elytra blue-green metallic; abdomen shiny black with apical segments orange-yellow.

Length: 10 mm.

Male: California, Triangle Blue Creek, Scott Mts., Trinity Co., August 26, 1936, (J. T. Howell) [CAS].

The male agrees with the female in all essential respects except that the antennae are apparently twelve-segmented and the apical sternite is deeply cleft forming two flaps.

Male genitalia.—(Pl. III, fig. 11.). Median lobe with a small apical

hook, recurved, slight, and not projecting beyond the lateral surface of the lobe, situated basally a distance about the width of the apex. The paramere is similar to the preceding species. The tegminite is arcuate apically, not acute. The ninth abdominal tergite is fan-shaped and without lateral lobes. The ninth abdominal sternite consists of two rods, contiguous basally and divergent apically; the apex is expanded, not furcate, only slightly enlarged laterally, the expanded portion of the apex recurved, heavily chitinous along the base and uniting at the juncture point of the eighth and ninth tergite and eighth sternite. The eighth tergite consists of two lobes, somewhat acute at the apex and base, expanded at the center and united by chitin. The eighth sternite consists of two large scoop-shaped lobes characteristic of the genus.

Individual variation.—A few specimens examined have a central dark spot on the thorax which is dark orange and the elytra are dark metallic blue-green.

Length: 8-12 mm.

Biology.—Some of the specimens examined were collected at night attracted to light.

Distribution.—This species seems to be restricted to California and those with definite locality data indicate that it is confined to the counties north of Santa Cruz, except for one specimen from Riverside County.

Specimens examined.—37: 27 ♂, 22 ♀.

CALIFORNIA: Marin Co., 1 ♀ (type no 8052); *no further data:* 5 ♂, [ANSP (Horn)]; 1 ♀ (incorrectly marked type no. 4795); 1 ♂, [MCZ (LeC.)]; 2 ♂, [Alab.]. Dunsmuir, Siskiyou Co., July: 1 ♂, [CNHM]. Tangle Blue Creek, Scott Mts., Trinity Co., Aug. 26, 1936, (J. T. Howell); 1 ♂; Carryville, Trinity Co., June 25, 1913: 1 ♀; Pine Crest, Tuolumne Co., July 22, 1937: 1 ♀; Mokel Hill, Calaveras Co.: 2 ♀; Willow Creek, Humboldt Co., June 12, 1916: 1 ♂, (F. E. Blaisdell); Klamath, Del Norte Co., July 18, 1934, (E. J. VanDuzee): 1 ♀; Idlewild, Riverside Co., June 28, 1928: 1 ♀; Gilroy Hot Springs, Santa Clara Co., May 27, 1925: 1 ♀; Shasta Co.: 2 ♀, [CAS]. Lampoc, July 13, 1932, (A. T. McClay): 22 ♂, 10 ♀, [McClay]. Mt. St. Helena, June 19, 1941, (D. J. & J. N. Knull): 4 ♂, [OSU]. *No further data:* 1 ♂, [RPM].

XANTHOCHROA MARINA Horn

Xanthochroa marina Horn, Proc. Calif. Acad. Sc., (2), 6: 394, 1896.

The dark head, the immaculate thorax and the dark elytra are constant color characters which distinguish this species from the foregoing.

Lectotype: ♂; Marin County, California, [ANSP (Horn), type no 8051].

Head short, coarsely rugose-punctate. Antennae apparently twelve-segmented, each segment three and one-half times as long as broad. Eyes large, oval, moderately deeply emarginate. Mandibles both bifid at the apex. Maxillary palpi elongate, apical segment broadest apically.

Thorax: notum very slightly longer than broad, widest towards apex, margins sinuate, surface coarsely and sparsely punctate. Sternum moderately rugose. Legs slender, claws simple. Elytra rugose, costate.

Abdomen: moderately rugose, apical sternite very deeply cleft forming two flaps.

Pubescence: thorax with long sparse, moderately coarse golden pubescence; elytra with short whitish pubescence, sternum, legs and abdomen with long whitish pubescence, antennae with very long golden pubescence.

Color: piceous-bluish with orange markings. Head piceous with front, clypeus, gula and mouthparts yellow. Antennae piceous-bluish. Thorax orange, sternum piceous. Legs piceous. Elytra piceous-bluish. Abdomen piceous-bluish.

Length: 10 mm.

Male genitalia.—(Pl. II, fig. 12). Median lobe with a large apical hook, recurved, and forming a straight blade which projects beyond the lateral surface and is situated basally a distance somewhat greater than the width of the apex. The paramere is similar to the preceding species. The tegminite is arcuate apically, not acute. The ninth abdominal tergite is fan-shaped and without lateral lobes. The ninth abdominal sternite consists of two rods, contiguous basally and divergent apically; the apex is expanded, not furcate, only slightly enlarged laterally, the expanded portion of the apex recurved, heavily chitinous along the base and uniting at the juncture point of the eighth and ninth tergite and eighth sternite. The eighth tergite consists of two lobes, somewhat acute at the apex and base, expanded at the center and united by chitin. The eighth sternite consists of two large scoop-shaped lobes characteristic of the genus.

Female.—Empire, Coos Co., Oregon, August 9, 1941, [CU].

Female agrees with the male in all essential respects except that the antennae appear eleven-segmented with the apical segment ringed and the apical sternite of the abdomen produced and truncate at the apex.

Individual variation.—The puncturation of the head is variable; some specimens have coarse, shallow, large punctures while others vary to small, distinct, sparse punctures. The coloration remains constant except that some specimens are distinctly metallic-blue especially on the basal portions of the elytra and on the head.

Length 7-9 mm.

Biology.—Unknown.

Distribution.—All known specimens are from California or Oregon. Apparently rare.

Specimens examined.—25: 11 ♂, 14 ♀.

CALIFORNIA: Marin Co.: 1 ♂, [ANSP (Horn), type no. 8051]. San Jacinto Mts., July 29, 1940, (D. J. & J. N. Knull): 1 ♂, [OSU]. Lampoc, July 13, 1932, (A. T. McClay): 1 ♂, 8 ♀; Paradise, April 24, 1941, (A. T. McClay): 1 ♀, [McClay]. Santa Rosa: 1 ♂, [AMNH].

OREGON: Empire, Coos Co., Aug. 9, 1941, (Borys Malkin): 5 ♂, 1 ♀, [CNHM]. Empire, Coos Co., Aug. 9, 1941, (B. Malkin): 1 ♂, [CU]. Pacific Grove, Aug. 17, 1930: 1 ♀, [OSU]. *No further data:* 1 ♀, [CAS]; 1 ♂, [CU]; 2 ♀, [Malkin].

XANTHOCHROA CENTRALIS Horn

Xanthochroa centralis Horn, Proc. Calif. Acad. Sc., (2) 6: 395, 1896.

This species is very similar to the preceding. It may be separated, in addition to the structure of the male genitalia, by the presence of a central black spot on the thorax and the piceous, instead of metallic-blue, elytra.

Lectotype.—♀, California, [Sylvania, (Ricksecker)], [ANSP (Horn), type no. 8053].

Head short, rugose-punctate. Antennae eleven-segmented, eleventh segment ringed; each segment three times as long as wide. Eyes large, distinctly, deeply emarginate. Mandibles both bifid at the apex. Maxillary palpi with apical segment slender, widest at the apex.

Thorax: notum slightly longer than broad; surface finely rugose; widest apically, sides sinuate; sternum very finely rugose; legs slender, claws simple; elytra distinctly costate, rugose.

Abdomen: moderately rugose, apical sternite produced, truncate at apex.

Pubescence: body with long, coarse, whitish hairs with some yellowish hairs mixed in, sparse on thorax, denser on elytra, short on the antennae.

Color: piceous with orange markings. Head piceous, with front, gula and mouthparts yellow; antennae piceous, basal segment yellow; thorax orange with a piceous central spot; legs, elytra and abdomen piceous, the latter with the apical sternite yellow.

Length: 10 mm.

Male.—California, [Sylvania, California, (Ricksecker)], [ANSP (Horn)].

The male differs from the female in the following ways: the antennae are apparently 12-segmented; the apical segment of the abdomen is deeply cleft forming two flaps.

Male genitalia.—(Pl. III, fig. 8). Median lobe with a distinct apical hook, which projects beyond the lateral surface of the lobe, recurved, distance from apex one and one-half times the width of the apex. Paramere short, trough-like. Tegminite produced at the apex, membranous at the base. Rods of ninth abdominal sternite with apex expanded, bifurcate, one tip blunt, not recurved; the other a blade-like flange which is recurved at the base and connects at the juncture point of the eighth and ninth tergite and eighth sternite. Tegminite somewhat truncate at the apex. Tergite of the eighth abdominal segment with two lobes, acute at the apex and base, united by a membrane which is coarsely granular. Setae present on the apical lobes of the eighth abdominal tergite and sternite.

Individual variation.—The central black spot on the thorax is reported to be absent in some specimens examined by Horn. However, it is present in all material examined by the author. In some of the specimens examined there are also two small lateral black spots on the thorax.

Length: 8-10 mm.

Biology.—Unknown.

Distribution.—This species found along the coast of California, from Sonoma County south to Monterey County. The type locality is given by Horn as being Sylvania, California. This locality does not appear on any map available to the author. However, the type specimens, according to Horn were collected by Ricksecker. His collection was purchased by Dr. Bradley and is now a part of the Cornell University collection. The lot record (C. U. Lot No. 126) has a note to the effect that specimens marked Syl. are from Sylvania, *Sonoma County*, California.

Specimens examined.—26: 15 ♂, 11 ♀.

CALIFORNIA: *No further data:* 1 ♀ [incorrectly marked type no. 8163]; 3 ♂; [MCZ LeC.)]. *No further data:* [*vide:* Horn, 1896, p. 395]: Sylvania, Sonoma Co., California. (Ricksecker)]: 1 ♀ [marked Lectotype no. 8053 in Horn Coll.]; 4 ♂ 3 ♀ (Marked paratypes); [ANSP]. Cornell University Lot 126, sublot 274 (no other data on specimens); Lot 126 equals Ricksecker Collection, sublot 274 equals "Xanthochroa n. sp.": 2 ♂, 2 ♀, [CU]. Big Basin Park, Santa Clara Co., July 1, 1934, (A. R. Mead): 1 ♀, [AMNH]; Santa Rosa, Sonoma Co., (Ricksecker): 1 ♂; Santa Rosa, Sonoma Co.: 2 ♂, 1 ♀; *no further data:* 1 ♂, 2 ♀; [AMNH]. Pacific Grove, July 1911: 2 ♂, 3 ♀. [Alab.] Santa Cruz, August 8, 1940, (O. J. & J. N. Knull): 2 ♀, [OSU].

NACERDES Dejean

Nacerdes Dejean, Cat. Col. ed. 3: 228, 1934.

Genotype: Necydalis notata Fab., (= *Cantharis melanura* L., *vide* W. Schmidt, Linn. Ent., 1: 29, 1846). [Designated by Arnett, 1950, p. 222.]

Anogcodes Dejean, Cat. Col. ed. 3: 228, 1834.

Genotype: Canthris melanura L. [Designated by Duponchel, *in* D'Orbigny, Dict. Univ. d'Hist. Nat., 1: 550, 1841.]

Nacerda Stevens, Man. Brit. Col., 1: 337, 1839.

Genotype: Cantharis melanura L. [Monobasic.]

This genus is closely related to the preceding genus, *Xanthochroa* Schmidt. It may be distinguished by the small eyes and the broad front, the only slightly emarginate eyes and the trifurcate apices of the rods of the ninth abdominal sternite. The two genera are very closely related and further study may show them to be congeneric.

There are forty-one species described in *Nacerdes*. They are found on all continents of the world, but only one species occurs in the Nearctic Region, the cosmopolitan *Nacerdes melanura* (L.). Inasmuch as this is the genotype, the following discussions of the species will serve to characterize this genus.

NACERDES MELANURA (Linné)

Cantharis melanura Linné, Sys. Nat., 10th ed., p. 403, 1758.—LeConte, Proc. Philad. Acad. Sc., 7: 21, 1854, (*Anoncodes*).—Champion, Biologia Centr.-Amer., (Ins. Col.), IV, 2: 117, 1889, (*Nacerdes*).—Horn. Proc. Calif. Acad. Sc., (2), 6: 391, 1896, (*Nacerdes*).

Type locality: Europe.

Oedmera apicalis Say, Des. N. Sp. N. A. Ins., March 1831, New Harmony, p. 9.—Boston Journ., 1: 188, 1835. [Cited as syn. of *Anoncodes melanura* (L.) *in* LeConte, Proc. Philad. Acad. Sc., 7: 21, 1854.].

Type locality: Pennsylvania.

This is a yellow species with the apices of the elytra piceous, and the

piceous area sharply limited. This character, in combination with the presence of only one apical tibial spur on the fore leg, defines the species.

Male.—Rochester, N. Y., Munroe Co., June 6, 1934, (C. R. Crosby), [Author].

Head as long as broad at the eyes; punctate, punctures shallow, broad, closely set, gula bare. Antennae apparently twelve-segmented, each segment except the first, second, eleventh, and twelfth three times as long as broad, slightly expanded apically. Eyes elongate oval, slightly emarginate, small. Mandibles both bifid at the apex. Maxillary palpi with apical segment triangular, broadest apically.

Thorax: notum coarsely rugose-punctate, broader than long, slightly broader apically, sides slightly sinuate, finely rugose at base of coxae. The sternum finely rugose-punctate. Legs slender, claws simple. Elytra coarsely rugose.

Abdomen: finely rugose; apical sternite very deeply emarginate, produced into two processes or flaps.

Pubescence: entirely covered with moderately long, fine, golden hairs, longest on the head and anterior margin of the thorax.

Color: yellow-testaceous with black or piceous markings. Head and antennae yellow-testaceous; prothorax and legs yellow-testaceous; elytra except for apical eighth yellow-testaceous. Apical eighth of the elytra piceous. Meso- and meta-thorax and venter of the abdomen piceous.

Length: 10 mm.

Male genitalia.—(Pl. III, fig. 13). The structure of the genitalia of this species is given in great detail in the introduction of this paper. The apices of the rods of ninth sternite are trifurcate, one tip blade-like; one stout and joining at the juncture point of the eighth sternite and tergite and the ninth tergite, and the remaining one forming a stout, recurved and long hook, the apex of which is free. The eighth tergite is heart-shaped with a transverse suture traversing the entire length, ending basally in two parallel rods which are united by chitin, and apically emarginate. The apical hook of the median lobe is situated basally a distance equal to three times the width of the apex. A small semi-chitinous setigerous lobe is present lateral to the ninth tergite and inserted at the juncture point of the ninth tergite and sternite and eighth sternite. The tegminite is broad and the apex is abrupt and acute.

Female.—Medina, N. Y., Orleans Co., July 17, 1940, (H. E. Pintler), [Author].

The female agrees with the male except that the apex of the last abdominal sternite is slightly and broadly emarginate, and the antennae are eleven-segmented, the apical segmented being only very slightly ringed at the center.

Length: 11 mm.

Individual variation.—Some specimens are somewhat dusky in appearance while others are a darker yellow approaching orange. The extent of

the piceous tips of the elytra varies but rarely becomes more than one-eighth the entire length of the elytra and never disappears. The transition from the yellow-testaceous color of the elytra to the piceous color of the tips is practically always abrupt and straight across the elytra, very rarely at an angle. The sculpture and vestiture is remarkably constant.

Biology.—This widespread species is found around cities. The larvae infest pilings and timber cast up by the sea, or brought down by floods, and they are able to resist immersion by the tide. It is an introduced species in the Western Hemisphere, probably carried by commerce in lumber, or in drift wood. It is of little economic importance, although it is watched carefully for possible damage of importance to pilings, etc.

Distribution.—This species is found throughout the Nearctic Region along the coast, up the Mississippi River, along the Saint Lawrence and is probably distributed at least along the coasts throughout the world.

Specimens examined.—Several hundred specimens of both sexes have been examined. To list specific information for all these specimens would be of little value. However, the following states from which specimens have been examined are listed: It is probably found in many others: Mass., Conn., N. Y., N. J., Penn., Del., D. C., Vir., N. C., Ga., Fla., Alab., La., Tex., Ark., Mo., Ill., Ind., Mich., Iowa, Wash., Ore., Calif. A complete list of localities is retained in manuscript form by the author and there are in addition approximately 200 specimens in the United States National Museum collection.

OEDEMERINAE Costa

Edemerini Costa, Fauna Regni Napoli, Edemer. p. 4, 1852.

This subfamily contains the remainder of the Oedemerids which constitute the bulk of the family. It is here tentatively divided into three tribes, Ditylini, Asclerini, and Oedemerini. The tribe Oedemerini does not occur in the Nearctic Region. The tribes Asclerini and Oedemerini are poorly separated at present and will remain so until examples of all of the genera can be examined. Perhaps then it will be determined whether the two tribes are distinct. (See Pl. I, fig. 5, for ♂ genitalia of Oedemerini)

The subfamily is characterized by the presence of two apical spurs on the fore tibiae, the antennae inserted free from the eyes, and the eighth sternite of the male lacking large and prominent scoop-shaped lobes. Many of the old world species show marked sexual dimorphism. The males of some of the species in the tribe Oedemerini have greatly enlarged hind femora, especially so in the genus *Oedemera*, hence the generic name. This character is lacking, however, in all Nearctic species.

The tribes Ditylini and Asclerini are readily separated. In the former, the body is stout, black, sometimes with a golden vestiture; the species are large and robust. The male has the ninth sternite in the form of two diverging rods, a character which links them rather closely with the Calopodinae and Nacerdinae. Horn's character for the genus *Ditylus*, — tarsi with several joints spongy-pubescent beneath, — does not apply to this genus alone and therefore cannot be used. The members of the tribe Asclerini are more slender, variously colored, and the male never has the ninth sternite as two diverging rods.

KEY TO THE TRIBES

1. Hind femore expanded in the males, (no Nearctic species) ..... *Oedemerini*
   Hind femora slender in both sexes 2
2. Body stout, black, sometimes with golden vestiture; male with ninth sternite two diverging rods; tergite consisting of two parallel chitinous rods, broadly joined by membrane, (one Nearctic genus only, *Ditylus*) ..... *Ditylini*
   Body slender, variously colored; male with the ninth sternite variously modified, but rarely as two diverging rods and if so, apices of rods not expanded ..... *Asclerini*

DITYLINI Semenow, 1894

Ditylidae, Semenow, Horae Soc. Ent. Ross. 28: 450, 1894.

This tribe is erected for the genus *Ditylus* Fisch.-Waldh., which appears to stand alone as a distinct group from any of the other Nearctic genera. Indeed, the species on casual examination would hardly be associated with the family and are as distinctly different as are the members of the subfamily Calopodinae. But upon closer examination, the morphology reveals a closer relationship with the Asclerini, and hence they are not given subfamily rank. An examination of more exotic material will either confirm the soundness of this tribe, or show that what here stands distinct has intermediates which will render this ranking unnecessary.

The members of this tribe as here recognized are large, black beetles, robust in appearance. The exoskeleton is well chitinized, hard. They resemble members of the genus *Pytho*. The bifid mandibles, the presence of two apical spurs on the fore tibia and the robust body as well as characters of the male genitalia serve to separate this tribe from the other members of this family.

DITYLUS Fischer von Waldheim

Ditylus Fischer von Waldheim, Mem. Soc. Imp. Nat.. Moscow, 5: 469, 1817.—W. Schmidt, Linn. Ent. 1: 24, 1846.— LeConte, Classif. Col. N. Amer., 258, 1862.—LeConte & Horn, Classif. Col. N. Amer., ed. 2, 404, 1883.— Semenow, Horae Soc. Ent. Ross., 28: 452, 1884.—Horn, Proc. Calif. Acad. Sc., (2), 6: 388.

Genotype: Ditylus helopioides Fisch-Wahl. (= *Helops laevis* F.) [Designated by Crotch, 1870, p. 229.]

The characters differentiating *Ditylus* from the other genera of Oedermeridae have been presented in the foregoing discussion of the tribe, as well as in the key to subfamilies, tribes and genera on a preceding page.

Generic features.—Concolorous black, punctate or punctate-rugose, with erect, black or golden stiff hair. Head short to moderately long. Antennae eleven-segmented, joints variously modified. The antennae are two-thirds the length of the body, and the second joint is longer than half of the third. The antennae are inserted between the eyes and the mandibles. Eyes small, only slightly emarginate, laterally situated. Both mandibles bifid at the apex. Maxillary palpi four-jointed, apical joint triangular, larger than other joints. The thorax is quadrate in some cases and apically expanded in others. The legs are slender; the fore tibia has two apical spurs. Tarsi with segments tomentose beneath as follows: fore, one to four, middle, one to four, hind, two to three, with the hind tarsal segment 1 sometimes with a narrow ventral, vertical stripe tomentose. Hind tarsal segment one long, much

longer than the others. Elytra costate, rugose. The abdomen with five sternites, the apical segment somewhat narrower than the others, with little difference between the sexes.

Length: 13-23 mm.

Male genitalia.—The median lobe is short, only slightly sinuous, without apical hooks or basal processes. The paramere is a plate with lateral margins forming a tube, apex emarginate, forming two lobes, apex of each lobe acute. The tegminite is semi-chitinous, lobe-like and arcuate at the apex. The tergite of the ninth abdominal segment is composed of two parallel rods connected by a broad area of membrane and sometimes by a narrow cross-bar of chitin. The ninth sternite is variously modified, consisting of two parallel rods, divergent apically and expanded. The eighth abdominal tergite consists of a plate, somewhat membraneous at the center. The sternite consists of two lobes which are broadly united basally; the lobes are variously modified.

Distribution.—Holarctic, with one species reported from Zanzibar.

KEY TO THE SPECIES

1. Antennae with segments 4-10 each long and slender, (5:1) 2
   Antennae with segments 4-10 each short, (3:1) or less 3
2. Black; vestiture short and dark ..... *gracilis* LeC.
   Black; vestiture longer and golden giving the beetle the appearance of being brown in color, (golden color form of *gracilis* LeC.)
3. Antennae with segments 4-10 each enlarged or expanded apically, (2½:1) ..... *caeruleus* Rand.
   Antennae with segments 4-10 linear, not greatly enlarged or expanded apically, (3:1) 4
4. Black; vestiture short and dark, (typical color form) ..... *quadricollis* LeC.
   Black; vestiture longer and golden giving the beetle the appearance of being brown in color, (golden color form of *quadricollis* LeC.)

KEY TO THE MALES

1. Eighth sternite with lobes bifid ..... *quadricollis* LeC.
   Eighth sternite without bifid lobes 2
2. Ninth tergite consisting of two chitinous rods joined at center, (H-shaped) *gracilis* LeC.
   Ninth tergite consisting of two separate chitinous rods united by membrane only ..... *caeruleus* Rand.

DITYLUS GRACILIS LeConte

Ditylus gracilis LeConte, Proc. Acad. Nat. Sc., Philad., 6: 18, 1854.—Horn, Proc. Calif. Acad. Sc., (2), 6: 389, 1896.

Ditylus vestitus LeConte, Rep. Pacific Rail Road Exped., 52, 1857, [New synonymy.]

Type locality: Washington.

This species may be distinguished from the other members of the genus by the elongate segments of the antennae. Segments 4-10 are approximately five times as long as the width at the center.

Holotype: ♂, Ore[gon], [MCZ (LeC.), type no. 4792].

Head: moderately long, distinctly punctate, punctures small and set well separated; gula transversely striate. Antennae 11-segmented, apical segment falsely ringed, segments four to ten elongate, five times as long as broad,

slightly expanded apically. Eyes moderate, somewhat elongate oval, very slightly emarginate. Maxillary palpi with the apical segment very broadly triangular, widest near the base.

Thorax: notum somewhat longer than wide, widest near the apex, sides sinuate, surface punctate, puncture same as on the head. Sternum rugose-punctate. Legs slender, claws simple. Elytra costate, moderately rugose.

Abdomen rugose, apical sternite evenly arcuate.

Pubescence: entirely covered except for the gula with short (long at anterior margin of the thorax) coarse, dense, whitish pubescence.

Color entirely metallic blue-black.

Length: 20 mm.

Male genitalia.—(Pl. IV & V, fig. 16). Median lobe: short, narrowed apically, slightly sinuous dorsally-ventrally; apex devoid of hooks. Paramere with two apical lobes, each lobe trough-like, forming a semi-circle, apex of each acute; emargination one-third the entire length; base arcuate with a slight dorsal expansion. Tegminite semi-chitinous, bottle-shaped, base with two chitinous parallel rods. Ninth abdominal sternite: two apically diverging rods, greatly expanded apically, the apex of the rods acute, with two convergent, basally projecting rods. The tergite large, well chitinized, H-shaped, membranous between arms. Eighth abdominal sternite consists of two stout lobes, the inner surface of which have a median longitudinal valley ending in a large apical excavation. The tergite is an emarginate plate both apically and basally; the basal emargination is membranous. Setae present on: apex of the tegminite, apex of the rods of the ninth sternite, apical lobes of the eighth sternite, apex of the eighth tergite.

Female.—Lincoln Co., Oregon, June 8, 1941, (F. W. Nunenmacker), [CNHM].

The female resembles the male in all details, there being no perceivable sexual dimorphism, with the possible exception of a slightly broader apical abdominal segment in the female.

Length: 20 mm.

Individual variation.—The antennal segment length to width ratio is somewhat variable in this species. Some specimens examined have the ratio as low as four to one. Some of the apical segments particularly are shorter. Segments 4 and 5 seem to be the most constant and surest guide for determination purposes. The shape of the thorax and the puncturation seem remarkably constant. The male genitalia are very distinct and serve best for a positive identification.

Length: 15-21 mm.

Synonymical notes.—*Ditylus vestitus* LeConte 1857 has through error been listed as a synonym of *Ditylus quadricollis* LeConte and not of this species. LeConte, however, lists it in his 1866 List as a synonym of this species. It was segregated as a species because of the golden appearance rendered to it by the long golden pubescence covering the entire insect. I

have examined the type specimen of *D. vestitus* (type no. 4891, MCZ) and although the individual segments of the antennae are only in a four to one ratio, I believe it to be conspecific with *D. gracilis*. There are no other morphological differences between the two type specimens. The male genitalia of examples of both forms are identical.

Biology.—Unknown, but probably very similar to that of *D. quadricollis* which follows.

Distribution.—Confined to the west coast from Plumas Co., California north to Ketchikan, Alaska.

Specimens examined.—typical: 39: 14 ♂, 16 ♀, 9 sex undetermined. Golden form: 8: 1 ♂, 3 ♀, 4 sex undetermined.

CALIFORNIA: Keddie, Plumas Co., June 15, 1940, (M. Gazier, T. Aitken): 1; [AMNH].

OREGON: Mary's Peak, Bendon Co., (G. F. Moznette): 1; Oct. 17, 1936, (R. G. Rozenstiel): 1; [AMNH]. Corvallis, Benton Co., July 6, 1896, (Schwarz): 1. Newport, Lincoln Co., May 18, 1930 (L. G. Hudson): 1; Astoria, Clatsop Co., April 14, 1946, (K. Gray, J. Schuh): 1; [AMNH]. Astoria, Clatsop Co., May 1, 1931 (M. C. Lane): 1 ♂, [CU]. Alsea Mt., Benton Co., May 26, 1934, (H. A. Scullen): 2, [AMNH]. Lincoln Co., (F. W. Nunenmacher): 5 ♂, (F. W. Nunenmacher); June 8, 1941: 2 ♀, 1, [CNHM]. Winchester Bay, Coos Co., April 13, 1947, (B. Malkin): 2 ♀; Tillamook Co., May 14, 1940: 1 ♀, [Malkin]. Boyer, May 3, 1936: 1 ♂; Baker Creek, Baker Co., June 18, 1938: 1 ♂; Bear Springs, June 18, 1939: 1 ♀, (F. N. & D. M. Fender); Maupin, Wasco Co., June 7, 1937: 1 ♀; Tillamook, Tillamook Co., May 21, 1940: 1 ♀, [Fender]. *No further data:* 1 ♂, [MCZ (LeC.) type no. 4792]; 1 ♀, [ANSP] (Horn Coll.); 1 ♀, [ANSP].

WASHINGTON: *No further data:* 1 ♂, 2, [ANSP]; 1 ♂ [CU]; 1, [CNHM]. July 1930, L. Chohman: 1, [AMNH].

ALASKA: Ketchikan, July 1916: 8 ♀, 5 ♂, [CNHM].

DITYLUS QUADRICOLLIS LeConte

Ditylus quadricollis LeConte, Lyc. Nat. Hist. N. York, 5: 157, 1851.—Rep. Pacific Rail Road Exped., 52: 1857.—Horn, Proc. Calif. Sc., (2) 6: 390, 1896.

Ditylus consors LeConte, List of Col. N. Amr., 70, 1866. (Listed as a syn. *D. quadricollis* LeC.) [nomun nudem]. [New synonymy.]

Type locality: Washington.

The best character for identifying this species is the ratio of width to length of each antennae segment. Segments 4-10 have a length to width ratio of 3:1. The punctation of the head and thorax is coarse, broad and slightly irregular.

Lectotypes: ♀, Oregon, [MCZ (LeC.) type no. 4789].

Head: short, coarsely and densely punctate, the punctures broad; gula rugose. Antennae eleven-segmented, apical segment constricted at the center; each segment three times as long as broad, very slightly expanded apically. Eyes small, very slightly emarginate, placed some distance from antennae. Both mandibles bifid at the apex. Maxillary palpi with apical segment small, somewhat broader apically, widest near the apex.

Thorax: notum much shorter than broad, surface rugose, somewhat broader apically, sides somewhat sinuate. Sternum rugose. Legs slender, claws simple. Elytra costate, rugose.

Abdomen: rugose, apical sternite evenly arcuate.

Pubescence: entirely covered by dense, short, moderately coarse, brown pubescence.

Color: entirely piceous.

Size: 18 mm.

Male.—Upper Soda Spring, Siskiyou Co., Calif., July, (J. E. Cottle), [Author].

The male agrees with the female in all essential respects.

Male genitalia.—(Pl. IV & V, fig. 14). Median lobe: short, narrowed apically, slightly sinuous dorsally-ventrally; apex devoid of hooks, base membranous. Paramere with two apical lobes, each lobe trough-like, forming a semi-circle, apex of each acute; emargination apical, one-third the entire length; base arcuate with a slight dorsal expansion. Tegminite semi-chitinous, short, apex acuate, base membranous. Ninth abdominal sternite: two diverging rods, expanded apically. The tergite large, weakly chitinized, consisting of two sinuous rods, parallel and joined by membrane. Eighth abdominal sternite consists of two stout lobes; the apical half of each lobe is bifid, forming two additional lobes which are deflected ventrad. The tergite is a simple plate, arcuate apically, membranous basally. Setae present on the apex of: tegminite, ninth sternite, eighth tergite and sternite.

Individual variation.—The antennal ratio is somewhat variable in this species as in the others. But rarely does the ratio exceed 3.5 to 1, or is it less than 2.5 to 1. The punctation is quite constant, varying slightly towards a rugose-punctate condition. The shape of the notum is variable, being distinctly quadrate in some specimens, whereas in others it is distinctly expanded apically, somewhat longer than broad. The male genitalia are very distinct and constant and serve best for a positive identification.

Length: 13-23.

Biology.—Mr. Richard Guppy furnishes nearly all of the information I have regarding the biology of this species (*vide*: Coleopterists' Bull., 2: 33, 1948). The larvae breed in old, wet logs of red cedar (*Thuja plicata*). They over-winter as adults, remaining in the pupal cell. The adults appear in May and are active thru August, or perhaps later. They are found running over swampy ground, or under logs in wet places. Mr. Guppy believes that they are intent on oviposition in this habitat. He reports finding one on flowers, that of the cultivated spiraea. The larval stage may last as long as three years. There are a few specimens in the United States National Museum collection marked reared from *Picea engelmanni*.

Synonymical notes.—*Ditylus consors* LeConte [MCZ (LeC.) type no. 4790] appears to be *Ditylus quadricollis* LeC. as it was listed by LeConte in his 1866 list. The type specimen is clothed with a brownish-golden vestiture similar to that of the golden form of *D. gracilis*. This is clearly the same situation as found in *D. gracilis*. I have examined several specimens of *D. quadricollis* LeC. exhibiting this color phase. The male genitalia are exactly the same as those of the typical *quadricollis*. The type has the an-

tennal segment ratio 3.5 to 1 and otherwise agrees with the type of *quadricollis* except for the color of the vestiture.

Distribution.—This species is recorded from Fresno Co., California northward through Oregon and Washington into British Columbia and Ketchikan, Alaska, eastward to Wallace, Idaho.

Specimens examined.—185: 25 ♂, 57 ♀, 103 sex undetermined.

CALIFORNIA: Upper Soda Spring, Siskiyou Co., July, (J. E. Cottle): 15 ♀, 1 ♂ [Author], Stevenson Creek, Fresno Co., June 9, 1920, alt. 5,000 ft., (H. Dietrich): 1 ♀; Glenwood, Santa Clara Co., May 27, 1908, (J. C. Bradley): 1 ♂; [CU]. Crescent City, Del Norte Co., July 13, 1939, (A. T. McClay): 1 ♂, [McClay]. Fallen Leaf Lake, Tahoe Co., July 4, 1915: 1; Shasta Co., May 1914: 2 ♂; [Alab.]. Sonoma Co., 1 ♀, [Malkin]. Pepperwood, Humboldt Co., May 26, 1935: 2; Carrville, Trinity Co., alt. 2450-2500 ft., June 16, 1934: 1; Gold Lake, Sierra Co., June 16, 1940, (M. Cazier & T. Aitken): 1; Clio, Plumas Co., June 16, 1940, (M. Cazier & T. Aitken): 1; [AMNH]. *No further data:* 1 ♀, [MCZ (LeC.)].

OREGON: Corvallis, Benton Co., June 6, 1935, (G. Ferguson): 1; Boiler Bay, Lincoln Co., May 18, 1930 (H. A. Scullen): 1; Independence, Polk Co., June 11, 1934, (K. Gray & J. Smith): 1; Parkdale, Hood River Co., July 1, 1938, (K. Gray & J. Smith): 1; Vernonia, Columbia Co., May 9, 1936, (K. Gray & J. Smith): 1; [AMNH]. Lincoln Co., June 8, 1941 (F. W. Nunemacker): 1 ♂; [CNHM]. Camas Valley, Douglas Co., June 14, 1936, (K. M. & D. M. Fender): 1 ♀; McMinnville, Yamhil Co., 2; Aug. 12, 1936: 1 ♀; April 11, 1936: 1 ♀; May 21, 1936: 1 ♀; April 12, 1936: 1 ♂; Pine Creek, Baker Co., June 13, 1941: 2 ♀, 1; Tollgate, Blue Mts., June 21, 1941: 1 ♂; Baker Creek, Baker Co., June 11, 1939: 2, 1 ♀; May 10, 1936: 1; (K. M. & D. M. Fender); Boyer, May 24, 1936: 1 ♂; Depton, May 9, 1940: 1 ♂, 3; [Fender]. Baker Creek, Baker Co., May 13, 1938, (K. M. & D. M. Fender): 1 ♀, 2 ♂; Newport, Lincoln Co., May 12, 1935, (J. Wilcox): 1; [Mackenzie]. Glenada, Lane Co., June 28, 1941: 1; vicinity of Vide, Lane Co., June 28, 1941: 1; Low Summit Pass, alt. 1150 ft., April 13, 1947, (B. Malkin): 1 ♀; Triangle Lake, Lane Co., (April 13, 1947): 1 ♂; Oak Ridge, Lane Co., June 20: 1 ♀; [Malkin]. *No further data:* 1 ♀ (type no. 4789); 2 ♂, 5 ♀, (LeC. Coll.); 1 ♂, [MCZ]. 1 ♂, 1 ♀, [RPM].

WASHINGTON: Bumping Lake, July 27, 1925, (R. W. Haegele): 1 ♂, [Idaho]. Steven's Pass, Index Co., July 9, 1931, (M. C. Lane): 1 ♀, [CU]. Sumner, alt. 72 ft., April 16, 1929: 1 ♀; Mt. Rainier, Shadow Lake, alt. 6,200 ft., (A. T. McClay): 1 ♂, [McClay]. *No further data:* 1 ♀ (Horn Coll.): 1 ♂, [ANSP]. 2 ♀, [MCZ LeC.)].

IDAHO: Priest River, alt. 2400 ft., June 7, 1929, (W. E. Schull): 1 ♀; Moscow, (J. M. Aldrick): 3 ♀, [Idaho]. Collins, July 24, 1898, (G. D. Bradford): 1 ♂, [Author]. Wallace: 1 ♂, 4 ♀, [Strochecker Coll.].

BRITISH COLUMBIA: Vernon, June 30, 1925, (R. Hopping): 1 ♀, [Alab.] Masset, Graham Is., (Mrs. M. C. Clark): 1 ♂; 1 ♀; Robson, May 27, 1937, (H. R. Foxlee): 1 ♀, [Author]. Vancouver: 1 ♀ [MCZ (LeC.)]; 1 ♂, [ANSP (Horn)]. Masset, Graham Is., (Mrs. M. C. Clark): 1 ♀, 1, [CU].

CANADA: Beaverfoot Range, Rocky Mts., (Province?) (W. Wonman): 1 ♀, [Author].

ALASKA: Ketchikan, June 1916, 2 ♂, 4 ♀, [CNHM].

NO DATA: 1 ♀, [ANSP].

DITYLUS CAERULEUS (Randall)

Upis caeruleus Randall, Boston Journ. Nat. Hist., 2: 20, 1938.—Haldeman, Journ. Acad. Nat. Sc. Philad., (2) 1: 96, 1848, (*Ditylus*).—Horn., Proc. Calif. Acad. Sc., 6: 389, 1896.

Type locality: Hallowell, Maine.

This is an eastern species and may be readily differentiated by the structure of each antennal segment. This species has the antennal length-width ratio of 2½ to 1, the width being measured at the center of the segment. The apex of each is distinctly expanded.

Male.—New York, June 18, [Author].

Head: short, coarsely, sparsely punctate. The punctures are large, set far apart with areas devoid of punctures. Area between the punctures smooth, shiny. Gula punctate at apex only, remainder transversely striated. Eyes small, set distant from the antennae, closer to the base of the mandibles. Both mandibles bifid at the apex. Maxillary palpi small, apical segment broadest at the apex, apex slightly sinuate with a semi-chitinous furrow extending the length of the apex.

Thorax: notum slightly broader than long, broadest near the apex, sides sinuate, surface distinctly, sparsely punctate, puncture larger and coarser than those of the head. Sternum moderately rugose. Legs slender, claws simple. Elytra vaguely costate, rugose.

Abdomen: apical sternite evenly arcuate, surface finely rugose.

Entire insect covered with very fine, short, moderately dense whitish pubescence, long at anterior margin of the thorax.

Color: black.

Length: 14 mm.

Male genitalia.—(Pl. IV & V, fig. 15). Median lobe: short, narrowed apically, arcuate slightly sinuous dorsally-ventrally, devoid of hooks. Paramere with two apical lobes, each lobe trough-like, forming a semi-circle, apex of each acute; emargination apical, one third the entire length; base arcuate, with a slight dorsal expansion. Tegminite semi-chitinous, bottle-shaped, apex expanded, slightly emarginate, base with sides chitinous. Ninth abdominal sternite; two diverging rods, expanded apically. Ninth tergite two chitinous rods, converging but not contiguous apically, united with membrane. Eighth tergite a simple, nearly quadrate plate, base widest, apex with laterally extending rods very slightly emarginate. Eighth sternite consisting of two large, truncate lobes, each with a ventral, diagonal, apically divergent ridge, and dorsally with a narrow suture apically convergent. Setae present on the apex of: tegminite, ninth sternite, eighth tergite and sternite.

Female.—Indian Falls, Mt. Marcy, June 10, 1942, (H. Dietrich), [CU].

The female agrees with the male in all essential respects.

Individual variation.—The antennal ratio is somewhat variable, but does not exceed 2½ by 1. The punctation is constant. The shape of the thorax is fairly constant. The male genitalia are very distinct and constant.

Length: 13 to 17 mm.

Biology.—Unknown, but no doubt similar to the other species of this genus.

Distribution.—Horn reports this species from the Lake Superior region

and eastward to Maine. I have seen specimens from as far west as Duluth, Minnesota, east to Maine, no farther south than the Adirondacks in New York state, and north to Gravenhurst, Ontario.

Specimens examined.—50: 4 ♂, 15 ♀, 31 sex undetermined.

MINNESOTA: Duluth: 1, [RPM]; 5, [USNM].

WISCONSIN: Mountain, June 20, 1935: 7, [CNHM].

MICHIGAN: Escanaba, (Hubbard & Schwarz): 1 ♂, 1 ♀; Eagle Har[bar?], L. Sup[erior]: 1; *no further data:* 1; [CNHM].

NEW YORK: Fulton Co., June 2, 1901: 1 ♀; Indian Falls, Mt. Marcy, June 10, 1942, (H. Dietrich): 1 ♀, [CU]. Oswegatchie, May 15, 1933, (J. D. Hood): 4; Top Mt. Whiteface, (J. N. Aldrich): 1 ♀, [USNM]. *No further data:* June: 1 ♀; June 18: 1 ♂, 1 ♀, [Author].

NEW HAMPSHIRE: Franconia: 2, [AMNH]. Mt. Moosilankee, June 3, 1912: 2, [CNHM]. E. Wakefield, June 14: 1; Mt. Washington, Base Station, July 7: 1 ♀, [Alab.]. *No further data:* 1, [ANSP].

MAINE: *No further data:* 1, [AMNH].

ONTARIO: Gravenhurst, 1900: 1, [CNHM]. Bethune, (H. Tyers): 1 ♂, 6♀, [CU]. Hastings, (Evans): 1 ♂, 1 ♀; Sudbury, 1893: 1, [USNM].

CANADA: *No further data:* 2, [ANSP (Horn)].

NO DATA: 1 ♀, [MCZ (LeC.)].

In addition there are three specimens in the LeConte collection at the Museum of Comparative Zoology which are labeled "Cal." which appear to be this species. They were set to one side by LeConte; apparently he questioned the data as do I.

ASCLERINI Semenow

Ascleridae Semen., Horae Soc. Ent. Ross., 28: 450, 1894.

This tribe contains the remainder of the Nearctic members of this family. Schenkling lists the genus *Sisenes* Champion under the tribe Oedemerini, but on the basis of the structure of the male genitalia, and the slender hind femora in both sexes and the shape of the palpi, I here retain this genus in the tribe Asclerini.

The members of this tribe are recognized by their slender bodies, moderate to small size, soft texture of the chitin, slender hind femora in both sexes and by having the male genitalia variously modified, the ninth sternite never as two apically divergent rods, with the sole exception of *Heliocis* n. gen. The latter is readily separated by the small size and slender body and is quite distinct from the genus *Ditylus*.

The separation of these remaining genera into two tribes is based upon the Nearctic species and members of the exotic genus *Oedemera* L. only. The final test of the arrangement can be made only when all of the genera have been studied. Undoubtedly, changes will then be made, but for the present purposes, this arrangement is thought to be useful.

Biology.—As far as known the adults are found on flowers and foliage.

KEY TO THE GENERA

1. Head greatly elongate, at least three times as long as width at the base of the antennae, prolonged into a beak ..... *Rhinoplatia* Horn
   Head elongate or not, but never three times as long as wide, not forming a beak 2
2. Ligula with a pronounced apical prolongation; body large, greatly elongate; maxillary palpi large, longer than the head ..... *Copidita* LeC.
   Ligula usually without apical prolongation; if present, not pronounced, not visible from above, or if pronounced, head elongate, size small; body not greatly elongate; maxillary palpi not large 3
3. Both of the mandibles bifid at apex; claws toothed at base ..... *Asclera* Steph.
   Mandibles bifid or not, but never bifid if claws are toothed at base 4
4. Only the right mandible bifid ..... *Alloxacis* Horn
   Both mandibles bifid, or both entire 5
5. Eyes deeply emarginate, with canthus; usually metallic colored ..... *Eumecomera* n. gen.
   Eyes at most only slightly emarginate, without canthus; usually not metallic colored 6
6. Head elongate; antennae with base well separated from eyes 7
   Head short; antennae with base approximate to eyes, and base of mandibles, inserted beneath eyes; eyes slightly emarginate ..... *Oxacis* LeC.
7. Eyes slightly emarginate; antennal segments somewhat flattened ..... *Sisenes* Champ.
   Eyes not emarginate; antennal segments not flattened ..... *Heliocis* n. gen.

KEY TO THE MALES

1. Median lobe without a dorsally recurved basal apodeme 2
   Median lobe with a dorsally recurved basal apodeme 4
2. Ninth abdominal sternite two, basally united, apically divergent, rods without apical expansion ..... *Heliocis*, n. gen.
   Ninth abdominal sternite two, basally united, apically divergent, rods with apical lateral expansion 3
3. Expanded area of rods of ninth abdominal sternite not projecting basally as well as apically ..... *Eumecomera*, n. gen.
   Expanded area of rods of ninth abdominal sternite projecting both basally and apically ..... *Sisenes* Champ.
4. Ninth sternite without ventral apical hooks 5
   Ninth sternite with ventral apical hooks 7
5. Basal median process of the median lobe with the apex abruptly expanded ..... *Asclera* Steph.
   Basal median process of the median lobe without such an expansion 6
6. Ninth abdominal tergite a solid plate; or if two rods united by membrane, then median lobe without subbasal apodeme ..... *Oxacis* LeC.
   Ninth abdominal tergite two rods united by membrane ..... *Alloxacis* Horn
7. Tegminite absent ..... *Copidita* LeC.
   Tegminite present, small ..... *Rhinoplatia* Horn

Heliocis new genus

Chrysanthia Horn, [not Schmidt, 1846], Proc. Calif. Acad. Sc., (2), 6: 408, 1896.

Genotype: Heliocis repanda (Horn) [= *Chrysanthia repanda* Horn]. [Present designation.]

This genus is characterized by the antennae being well separated from the eyes, closer to the base of the mandibles, inserted closer together than the eyes, and by the unemarginate eyes. The male genitalia resemble somewhat those of *Ditylus*, having the ninth sternite in the form of two apically divergent rods, the median lobe and paramere simple. In fact, the male genitalia are distinct from *Ditylus* only in certain details. If only genitalic characters were used, one would be inclined to include this genus in the

tribe Ditylini. However, the external morphology is quite different and by the following diagnosis may be easily separated from *Ditylus*. Althohgh probably closely allied to the tribe Ditylini, it is here retained in the tribe Asclerini.

Generic diagnosis.—Small, head long, much longer than broad. Antennae eleven-segmented, each segment elongate; inserted distant from the eyes, close to the base of the mandibles. Both mandibles bifid at the apex. Maxillary palpi four-segmented, apical segment large, triangular. Pronotum slightly longer than broad, broadest behind the apex, apex somewhat narrowed. Legs slender, claws simple. Abdomen with five visible sternites. Color of known species purplish-black with orange markings.

Male genitalia.—See description under *H. repanda.*

Distribution.—As far as known, this genus is limited to the Nearctic Region, confined to the states of Florida, Texas, and Arizona with one record of a specimen each from Utah and the District of Columbia.

Nomenclatorial notes.—This genus is erected to provide for the one Horn species, *Chrysanthia repanda,* a description of which follows. Horn at the time he assigned *H. repanda* to the genus *Chrysanthia,* was somewhat dubious as to its proper association. The two genera, *Heliocis* and *Chrysanthia* are close, but may be readily separated as follows: head abruptly narrowed behind the eyes in *Heliocis,* gradually narrowed in *Chrysanthia;* pronotum widest behind the apex in *Heliocis,* at the apex in *Chrysanthia;* antennae nearly as long as the body in *Heliocis,* not over half the length of the body in *Chrysanthai.*

Heliocis repanda (Horn) new combination

Chrysanthia repanda Horn, Proc. Calif. Acad. Sc., (2) 6: 408, 1896.

This species may be recognized by the moderately long head, the small size and the black head with orange thorax and purplish-black elytra. Both mandibles are bifid at the apex and the claws are simple.

Lectotype.—♀, Florida, [ANSP (Horn), lectotype no. 8070].

Head: long, two times as long as broad, irregularly punctate, punctures coarse and broad; gula finely transversely rugose. Antennae eleven-segmented, each segment long, five times as long as broad, inserted distant from the eyes. Eyes small, oval, entire. Mandibles are both bifid at the apex. Maxillary palpi with the apical segment nearly linear, widest near the middle.

Thorax: notum slightly longer than broad, somewhat broader apically, sides moderately sinuate, surface rugose to base of coxae. Sternum rugose. Legs slender, claws simple. Elytra rugose, sub-costate.

Abdomen: apical sternite slightly and broadly emarginate.

Pubescence: entirely clothed with short, fine golden pubescence.

Color: purplish-black with orange markings. Head black with apical half orange. Antennae piceous; thorax orange with vague piceous markings at the base of the coxae. Legs piceous, elytra purplish-black; abdomen piceous, shiny.

Length: 8 mm.

Allotype.—♂, Florida, [ANSP (Horn), type no. 8070.2].

The male agrees with the female in all essential respects. The antennae are eleven-segmented, the apical segment distinctly ringed, but not giving the appearance of two segments. Apical segment of the abdomen truncate at the apex.

Male genitalia.—(Pl. XI, fig. 17.). The median lobe is short, broad, somewhat lobe like, arcuate at the apex, base semi-chitinized. The paramere is trough-like, with the sides curved, apex triangularly emarginate. Tegminite membranous, trough-like with the sides chitinized; apex slightly emarginate. Ninth abdominal sternite; two basally united, apically divergent rods which are broadly connected by membrane which extends loosely between the two forming a ventral wall, apex of rods acute. Tergite a simple membranous lobe or plate, broad at the base, broadened apically and evenly arcuate, center with two parallel chitinized rods. Eighth abdominal sternite two large lobes, heavily chitinized, apex truncate-arcuate; ventral surface concave, lobes united only at the daily midway between base and apex by membrane. Tergite two chitinized plates broadly united by nearly chitinous membrane, emarginate at the apex. Setae present as very small hairs on the apex of the ninth tergite, and eighth sternite and tergite.

Individual variation.—The genitalia and the sculpture and vestiture of this species are quite constant. The color is somewhat variable. Some specimens have the apical half of the head dark and the basal half orange. The coloration of the elytra varies from a distinctly metallic purple to a piceous or black color.

Length: 5-8 mm.

Biology.—Unknown.

Specimens examined.—50: 17♂, 26♀, 7 sex undetermined.

FLORIDA: Enterprise, (Hubbard & Schwarz): 1 ♀, [USNM]. Armond, April 11, 1913: 2, [AMNH]. Dunedin, March 1, 1930: 2 ♂, 2 ♀, [CU]. S. Fla., April 1, 1923, (J. S. Hine): 1 ♂; Ocala, May 17, 1939, (D. J. & J. N. Knull): 4 ♂, [OSU]. Enterprise: 4 ♂ 11 ♀, [RPM]. *No further data:* 1 (specimen marked "allied to Rhinoplatia"). 1 ♂ (marked type no. 8162), [MCZ (LeC. Coll.)]: 1 ♀ (lectotype no. 8070); 1 ♀ (allotype no. 8070.2); 1 ♀ (type no. 8070.3); 1 ♀ (type no. 8070.4) [ANSP (Horn)]; 2, [AMNH].

TEXAS: Burnett, (Hubbard & Schwarz): 1 ♂; Kerrville, April 14, 1907, (G. Durham): 1 ♀, [USNM]. Bastrop N. P., May 1, 1941, (D. J. & J. N. Knull): 2 ♂, 2 ♀, [OSU]. *No further data:* 1 ♀, [MCZ (LeC.)] 1 ♀ (type no. 8070.5); 1 ♀ (type no. 8070.6); 1 ♀ (type no. 8070.7); 1 ♀ (type no. 8070.8); 1; (Horn coll.); 6 [ANSP].

ARIZONA: 1♂, [ANSP (Horn) type no. 8070.9].

DISTRICT OF COLUMBIA: 1 ♀ [ANSP (Horn) type no. 8070.10].

Eumecomera new genus

The members of this genus may be recognized by the bifid mandibles, the simple claws, the broad thorax and the deeply emarginate eyes. It is here erected for three species placed in the genus *Copidita* by Horn which

on external appearances resemble certain members of that genus, but which are very distinct when examined critically both as to external morphology and to the male genitalia. These three species are more closely related to the Palearctic members of the genus *Chrysanthia*.

Genotype: *Asclera obscura* LeC. [Present designation.]

Generic diagnosis.—Form robust. Head moderate; antennae eleven-segmented, apical segment only slightly ringed or constricted at the center. Eyes small, oval, moderately protruding, deeply emarginate, emargination filled by a canthus. Both mandibles bifid at the apex. Maxillary palpi four-segmented, apical segment triangular, widest beyond the apex. Thorax as broad as long or broader, widest towards the apex, sides sinuate. Legs slender, claws simple. Apical sternite of the abdomen modified between the sexes. Five visible sternites in both sexes.

Male genitalia.—Median lobe a simple lobe with a very slight basal recurved process. Paramere trough-like, base arcuate, apex bifid, forming two lobes the apices of which are modified in the species. Tegminite a simple semi-chitinized lobe. Ninth abdominal sternite two apically divergent rods, the apices of which are expanded laterally and dorsally; tergite a simple plate which is widest towards the apex. Eighth abdominal sternite two lobes united at the center by membrane; tergite two simple plates united by a broad central area of membrane.

Distribution.—The genus as here recognized is restricted to western North America, from the Rocky Mountain region, west to the Pacific Coast.

KEY TO THE SPECIES

1. Color entirely metallic blue-green ..... *cyanipennis* Horn
   Color of head black, thorax orange, elytra somewhat metallic blue 2
2. Thorax with stout black hairs sparsely mixed with short whitish hairs ..... *bicolor* Horn
   Thorax without black hairs intermixed ..... *obscura* LeC.

KEY TO THE MALES

1. Lobes of paramere each with a stout recurved process ..... *obscura* LeC.
   Lobes of paramere without such processes 2
2. Apex of paramere lobes acute, gradually tapering to apex ..... *bicolor* Horn
   Apex of paramere lobes stout, abruptly tapering to apex ..... *cyanipennis* Horn

Eumecomera bicolor (Horn) new combination

Ditylus bicolor Horn, Trans. Amer. Ent. Soc., 3: 88, 1870.—Proc. Calif. Acad. Sc., (2), 6: 403, 1896.

This species is distinguished from the other two by the presence of stout black hairs mixed with short whitish hairs on the notum of the thorax and by the distinct male genitalia.

Holotype.—♂, Fort Klamath, Oregon, Wm. M. Gabb; [ANSP (Horn) holotype no. 8056].

Head: punctate, punctures large, shallow, set closer than their width; somewhat longer than broad. Antennae eleven-segmented, apical segment scarcely constricted at the center. Eyes small, oval, moderately deeply emarginate, moderately protruding. Both mandibles bifid at the apex. Max-

illary palpi with the apical segment short, broad, widest beyond the center.

Thorax: notum slightly broader than long; coarsely punctate, punctures shallow and nearly their width apart; sides sinuate. Sternum rugose. Legs slender, claws simple. Elytra rugose.

Abdomen: rugose, apical sternite deeply emarginate.

Pubescence: entire body covered with coarse, long, moderately dense pubescence; pronotum with long coarse, black hairs arising from some of the punctures and intermixed with white hairs.

Color: metallic blue with orange markings. Head metallic blue except mentum which is yellow. Antennae piceous. Thorax orange with two lateral spots at base of coxae. Legs, elytra and abdomen metallic blue.

Length: 8 mm.

Male genitalia.—(Pl. VI, fig. 18). Median lobe slender, lobe-like, apex narrower than the body, narrowed abruptly at apical eighth of the lobe. Paramere: trough-like, sides extending dorsally and nearly contiguous; apex furcate, one-eighth the entire length, apex of the lobes very acute, slightly reflected inwards, tapering to apex gradually. Tegminite a chitinous lobe, arcuate at the apex, base with a small chitinous plate separate. Ninth abdominal sternite two rods expanded apically with dorsal arms approaching tergite; apex acute. Tergite a simple plate most heavily chitinized laterally, widest at center, united by membrane. Tergite two simple plates arcuate at apex and base, united by a broad central area of membrane. Setae present on the apex of the ninth abdominal sternite.

Female.—Cypress Ridge, Marin Co., California, [AMNH].

The female resembles the male in all respects except that the apical abdominal sternite is shallowly emarginate.

Individual variation.—The extent of the area of the thorax bearing stout black hairs varies in the specimens examined. Some have these hairs distributed over nearly the entire area of the notum, while others have them limited to a small area at the posterior center. All specimens examined have these hairs. The coloration of the elytra varies from a distinctly purple hue, to a piceous color. The length varies from 7-11 mm.

Biology.—Unknown.

Distribution.—This species was known to Horn from Fort Klamath, Oregon and "Northern California." I have seen specimens, other than the type, only from Marin County, California.

Specimens examined.—9: 5 ♂, 4 ♀.

OREGON: Fort Klamath, (Wm. M. Gabb): 1 ♂?, [ANSP (Horn), Holotype no. 8056].

CALIFORNIA: Mt. Diablo, Marin Co., April 8, 1934: 1 ♂; Cypress Ridge, Marin Co., April 19, 1920: 3 ♂, 2 ♀, [AMNH]. Mt. St. Helena, June 19, 1941, (D. J. & J. N. Knull): 2 ♀, [OSU].

Eumecomera obscura (LeC.) new combination

Asclera obscura LeConte, Proc. Acad. Nat. Sc., Philad., 7: 21, 1854.—Horn, Proc. Calif. Acad. Sc., (2), 6: 402, 1896 (*Copidita*).

This species is distinct from the others by having the thorax orange and the pronotum without stout black hairs mixed with the white. The paramere of the male genitalia has the apex of the lobes strongly recurved and hooked, a character which may be readily seen without dissection if the genital organs are extruding.

Holotype: ♀, New Mexico, [MCZ (LeC.), type no. 4793].

Head: Punctate, punctures of moderate size, spaced closer than the width of the punctures; short. Antennae eleven-segmented, apical segment only slightly constricted at center; each segment distinctly broader apically, except apical segment. Antennae inserted some distance from the eyes, between the base of the mandibles and the eyes. Eyes distinctly emarginate, small, oval, moderately protruding. Mandibles both bifid at the apex. Maxillary palpi with the apical segment broadly triangular, widest towards the apex.

Thorax: punctate, punctures large, shallow and closely set. Slightly broader than long, broadest towards apex, sides sinuate. Sternum rugose. Legs slender, claws simple. Elytra rugose, costate.

Abdomen: apical sternite emarginate.

Pubescence: entire insect except the gula clothed in short, moderately dense golden pubescence.

Color: black with orange markings. Head black except mentum which is yellow and mouth-parts which are testaceous. Antennae piceous with golden shade due to pubescence. Thorax orange wtih two shiny black spots at base of coxae. Legs piceous with golden pubescence shading. Elytra piceous. Abdomen piceous except for the apex of the last ventral segment which is yellow.

Length: 11 mm.

Allotype: ♂, New Mexico, [MCZ (LeC.)].

The male resembles the female except that the apical abdominal sternite is deeply emarginate.

Male genitalia.—(Pl. VI, fig. 19). Median lobe; a simple lobe, short, stout, apex unmodified, base with a slightly recurved process. Paramere trough-like, base arcuate, apex bifurcate forming two lobes, the apex of each recurved, forming a strong hook. Tegminite a simple semi-chitinized lobe, apex distinct, arcuate. Ninth abdominal sternite two apically divergent rods, apices of which are expanded laterally and dorsally, united dorsally and joining the tergite. Tergite a plate which is widest near the apex, apex arcuate. Eighth abdominal sternite two lobes united at the center by membrane, apex arcuate, base truncate; tergite two shorter, less heavily chitinized lobes shaped similar to the sternite. Setae present at the apex of tegminite.

Individual variation.—This species is quite constant, varying most in length which may be from 8 to 13 mm.

Biology.—Adults reported on *Lippia* sp. in Arizona.

Distribution.—This species is confined to the western part of North

America and is known from California, New Mexico, Texas, Nevada, Arizona, Utah and Colorado.

Specimens examined.—118: 34 ♂, 52 ♀, 44 sex undetermined.

CALIFORNIA: Big Basin Park, July 1, 1934, (A. R. Mead): 1, [AMNH]. Santa Barbara, July 30, 1927: 1 ♀, [CU].

UTAH: Am. Fork, July 26, 1906, (H. F. Thornley): 1 ♀ [USNM]. Coalville, July 10, 1942, (H. H. Bullock): 1 ♂, [Mackenzie]. Dividend, July: 1; Zion N. Park, Aug. 20, 1935: 2; [CNHM]. Ogden, July 25, 1920: 1; Provo, Aug. 1, 1920: 1, [AMNH].

COLORADO: Pikes Peak, alt. 7,000-8,000 ft., (H. F. Wickham): 3; Buena Vista, alt. 7,900-8,000 ft., July 16, 1896: 1; Colorado Springs, (Hubbard & Schwarz): 6; [USNM]; 1 ♀ (same data), [CU]. Glenwood Springs, (Dr. A. Fenyes): 2 ♀, [AMNH]. *No further data:* 2 ♀, [AMNH]; (H. P. Chandler): 1 ♀, [Idaho]; 1 ♀, [MCZ LeC.)].

ARIZONA: Williams, Aug. 9, 1938: 1 ♀; Huachuca M., July 20, 1937: 4 ♀; Chiricahua M., July 26, 1937: 2 ♂, 1 ♀, 1; Jerome, Aug. 18, 1938: 1 ♂, 2 ♀; Oak Cr. Can., Aug. 15, 1938: 2 ♂, 2 ♀, (D. J. & J. N. Knull), [OSU]. Lakeside, alt. 6600 ft., Aug. 10, 1947, (G. P. Mackenzie): 7 ♂, 5 ♀, [Mackenzie]. Chiricahua Mts., Aug. 22: 1 ♂, [RPM]. Kirkland, alt. 4,500 ft., Peeples Valley, Yampai Co., Aug. 22-24, 1927, (Cornell U. Exp.): 2 ♂, 1 ♀; Grand Canyon, Aug. 5, 1917, (Cornell U. E p.): 1 ♀, [CU]. Whiteriver, 8-15 mi. N. E., alt. 6,800 ft., (D. Rockefeller): 2 ♂, 2 ♀; Huachuca Mts.: 2 ♀; Grand Canyon, Indian Garden, alt. 3,800 ft., (P. E. Geier): 3 ♀, [AMNH]. Prescott, Sept. 1, 1940, (G. P. Mackenzie): 1, [Mackenzie].

NEVADA: Dixie, N. F., Aug. 1, (J. N. Knull): 2 ♀, [OSU].

NEW MEXICO: James Mts., (J. Woodgate): 1 ♀; Cimaron Canyon, July 12, 1929, (G. P. Engelhardt): 1 ♂; Torrance Co., (J. R. Douglas): 1 ♀; Las Vegas, July 8, (Barber & Schwarz): 26, [USNM]. Bandelier Aug. 8, 1935: 1, [CNHM]. Beulab, (H. Skinner): 2 ♂; Santa Fe Canyon, alt. 7,000 ft., Aug. 1880, (Snow): 3 ♂, 1 ♀, [ANSP]. Albuquerque, (Oslar): 4 ♀, [AMNH]. Ft. Wingate: 3 ♂, 9 ♀, [USNM]. James Mts., (Jro. Woodgate): 1 ♂, 2 ♀, [RPM]. *No further data:* (F. H. Snow): 1 ♀, [ANSP]; 1♂, 1 ♀, [MCZ (LeC.)].

TEXAS: Chisos Mts., July 17, 1946, (D. J. & J. N. Knull): 1 ♂, [OSU].
NO DATA: 1 ♀, [Idaho].

Eumecomera cyanipennis (Horn) new combination

Ditylus cyanipennis Horn, Trans. Amer. Ent. Soc. 3: 89, 1870.—Proc. Calif. Acad. Sc., (2), 6: 404, 1896, (*Copidita*).

This species is distinct from the other two of this genus in the striking coloration. The entire insect is a distinct metallic blue color. The male genitalia are distinct, but very similar to *E. bicolor* (Horn).

Holotype: Coast Range of California, South of San Francisco, (Mr. Wm. M. Gabb), sex undetermined, [ANSP (Horn) type no. 8057]. The type specimen is in very poor condition, apparently having suffered from attacks by dermestids. The following description is based only in part on the type. There is little doubt about the association of specimens, however, because this is a very distinct species.

Male.—Santa Barbara, California, April 10, 1933, (A. T. McClay), [McClay].

Head: long, about one and one-half times as long as broad at the eyes; coarsely and deeply punctate, punctures set about equal their width apart; punctures extending to and including the gula. Antennae eleven-segmented,

apical segment scarcely constricted at center. Eyes small, elongate oval, moderately deeply emarginate, somewhat protruding. Mandibles very slightly bifid at the apex. Maxillary palpi with the apical segment broad, widest towards the apex.

Thorax: notum as broad as long, sparsely and deeply punctate, punctures set about equal their width apart, more than their width at center, sides smooth. Sternum moderately rugose. Legs slender, claws simple. Elytra rugose.

Abdomen: moderately rugose, apical segment moderately emarginate.

Pubescence: entire insect covered with moderately dense, fine, short whitish pubescence, sparse on the thorax, a few, very long, piceous hairs on the gula.

Color: entire insect metallic blue.

Length: 6 mm.

Male genitalia.—(Pl. VI, fig. 20). Very similar to *E. bicolor* (Horn) except that the apex of the ninth sternite is broader and more arcuate, and the lobes of the paramere are broader and abruptly tapering towards the apex.

Female.—same data as male example.

The female agrees with the male except that the apical abdominal sternite is evenly emarginate.

Individual variation.—Very little variation observed except that the apical abdominal sternite of the female may be somewhat emarginate.

Length: 6-9 mm.

Biology.—Unknown. This species seems to be rare.

Specimens examined.—25: 11 ♂, 8 ♀, 6 sex undetermined.

CALIFORNIA: Coast Range of California, South of San Francisco, (Mr. Wm. M. Gabb): 1, [ANSP (Horn) type no. 8057]. Caresbad Bay, June, 1934: 1; San Antonio Canyon north of Ontario, 5,700 ft., June 20, 1931, (H. A. Scullen): 2 ♀, [AMNH]. Santa Clara, (A. Koebele): 1 ♀; Pasadena, (Dr. A. Fenyes): 1 ♀, [USNM]. Santa Barbara, April 10, 1933, (A. T. McClay): 4 ♂, 1 ♀; San Bernardino Co., June 20, (A. T. McClay): 1 ♂; Saticoy: 1 ♂, [McClay]. San Gabriel, April 17, 1943 (G. P. Mackenzie): 1 ♂, 1 ♀; Mt. Wilson, June 8, 1940 (G. P. Mackenzie): 4 ♂, 2 ♀, 4, [Mackenzie].

SISENES Champion

Sisenes Champion, Biologia Centr.-Amer., Col. IV, 2: 111, 1889.—Horn, Proc. Calif. Acad. Sc., (2), 6: 409, 1896.—Seidl., Naturgesch. Ins. Deutschl., V, 2: 876, 1899.

Genotype: Sisenes lyciformis Champ. [Designated by Arnett, 1950, p. 224.]

The genus *Sisenes* Champion was erected for twenty-one species of very distinct Central American species, somewhat resembling certain Lycids, one of which extends into our fauna. All are distinctively marked, the Nearctic species being perhaps our most colorful member of the family. The genus may be readily recognized by the elongate head and thorax, the somewhat flattened segments of the antennae, the bifid mandibles and the emarginate eyes.

Generic diagnosis.—Head moderately elongate, eyes emarginate; antennae slender, eleven-jointed, inserted at a distance from the eyes. Both mandibles bifid at the apex. Apical segment of the maxillary palpi linear, widest beyond

center. Thorax slightly longer than broad, somewhat expanded apically, sides somewhat sinuate. Legs slender, claws simple. Elytra costate.

Male genitalia.—Median lobe short, base enlarged, without processes, tapering to a narrow shaft, apex enlarged. Paramere a trough-like plate, wide basally, without basal processes, apex narrower, bifid. Tegminite a simple membranous lobe with indefinite chitinous central area. Ninth abdominal sternite two rods which are contiguous basally, parallel for nearly their entire length and then sharply divergent, the apex greatly expanded, the expanded area about one-half the entire length. The expanded area is in the form of two lobes which extend dorsally and basally forming a sheath, connected in the center by the somewhat membranous tergite. The eighth abdominal sternite and tergite each consist of two large lobes, the sternite being the largest.

Distribution.—This genus is limited to Central America with one species extending to Arizona.

SISENES CHAMPIONI Horn

Sisenes championi Horn, Proc. Calif. Acad. Sc., (2), 4: 435, 1894.—Horn, Proc. Calif. Acad. Sc., (2), 6: 410, 1896.

This species may be distinguished at once by the brilliant satiny orange elytra, the black head and the black thorax with two broad lateral orange stripes.

Lectotype.—♂, Arizona, [ANSP (Horn), lectotype no. 8069].

Head: elongate, two times as long as the width at the eyes; rugose, gula bare. Antennae eleven-segmented, each segment three times as long as broad, each segment very slightly broadened apically, set some distance from the eyes, each segment somewhat flattened. Eyes moderate in size, slightly emarginate, somewhat elongate oval. Mandibles both bifid at the apex. Maxillary palpi with the apical segment triangular, broadest near the center.

Thorax: notum slightly longer than broad, somewhat expanded apically, side somewhat sinuate, surface very finely rugose, inflexed sides very finely and sparsely punctate. Sternum moderately finely rugose. Legs slender, claws simple. Elytra costate, rugose. Abdomen finely punctate, apical sternite slightly emarginate.

Pubescence: entire insect covered with short, moderately fine, dense orange pubescence, most dense on elytra.

Color: orange with bluish-black markings. Head, antennae, legs and abdomen black, the latter bluish-black and shiny. Thorax black with two broad lateral orange stripes. Elytra brilliant satiny orange.

Length: 12 mm.

Male genitalia.—(Pl. VII, fig. 21). Median lobe short, base enlarged, without processes, tapering to a narrow apex; apex enlarged, bulbous, not hooked. Paramere: a trough-like plate, wide basally without basal processes; apex narrow, emarginate, forming two acute apical processes. Tegminite a simple membrane with an indefinite chitinous central area. Ninth abdominal sternite consisting of two rods which are contiguous basally, and parallel

apically until a point of sharp divergence and a great apical enlargement in the form of two lobes which are as long as the rods and extend dorsally and basally. Tergite a small membranous plate with lateral chitinous rods, situated between the lobes of the sternite. Eighth abdominal segment with the sternite and the tergite consisting of two large lobes, the tergite united by chitin. Setae present on the apex of the lobes of the eighth sternite and tergite.

Allotype.—♀, Arizona [ANSP (Horn) type no. 8069.2].

The female agrees with the male in all essential respects showing no sexual dimorphism.

Individual variation.—This species is remarkably constant, showing some color variation, especially in the color of the elytra which is at times darkened.

Length: 10-12 mm.

Biology:—Unknown.

Distribution.—This species is known in this fauna only from Arizona.

Specimens examined.—28: 20 ♂, 6 ♀, 2 sex undetermined.

ARIZONA: Chiricahua Mts., June 20, (Hubbard & Schwarz): 11 ♂, 2 ♀; Palmerlee, Cochise Co., June 21: 1 ♀, [USNM]. Fort Grant, Pinaleno Mts., July 17, 1917: 1 ♂; Santa Rita Mts, June 15, 1924, (C. T. Vorhies): 1 ♂; Webber's Cabin, 7500-8500 ft., July 27, 1917: 2 ♂, 1 ♀; Mt. Lemon, July 27, 1917, (R. C. Shannon): 3 ♂, 1 ♀; (S. Catalina Mts.), [CU]. Piney Canyon, alt. 6,000, Cochise Co., July 19, 1919, (Winter Stone): 1; *no further data:* 1 ♀ (type no. 8069.2); 1, (type no. 8069.3), [ANSP (Horn)]; 2 ♂, [MCZ (LeC.) one marked type no. 8164].

OXACIS LeConte

Oxacis LeConte, New Species Col, I. 165, 1866.—LeConte & Horn, Classif. Col. N. Amer., ed. 2, 405, 1883.—Champion, Biol. Centr.-Amer., Col. IV, 2: 110, 1889 and 149, 1890.—Horn, Proc. Calif. Acad. Sc., (2), 6: 410, 1896.

Genotype: Asclera cana (LeConte). [Designated by Arnett, 1950, p. 223.]

This genus has the greatest number of North American representatives of any genus of Oedemerids. The species are distributed throughout both North and South America. As here recognized it contains twenty-seven Nearctic species. The genus is not easily definable. It consists of a number of closely related species groups exhibiting certain morphological characters which in other sections of the family form the basis of distinct genera, yet here they are considered as subgeuera. The male genitalia are very similar in all species, but distinct enough in all cases to define subgenera and often species. It is a difficult group to understand, and perhaps the present consideration will be looked upon as being inconsistent with the classification elsewhere followed. My reasons for adopting the present system are briefly as follows: 1) the general pattern of the male genitalia throughout all of the species of the several subgenera is the same, and this type may be readily distinguished from the patterns elsewhere observed; 2) the external morphology presents a combination of characters which may readily separate all of the species here placed from all of the remaining species in the family; 3) a further splitting of genera in the light of the family studied from a world point of view is cumbersome and would serve no practical purpose.

A generic study of all of the Oedemerids will show a decided need for uniting many of the present genera because many of the characters now employed, I believe, will prrove to be generically unsound. It is in the light of these considerations that I have here elected to follow a more conservative scheme of classification, but for convenience in the present study have erected several subgenera in an attempt to retain a certain balance or consistency throughout the paper. I feel, however, that the classification of this section of the family is far from sound, an idea which may only be proven or disproven by continued study.

This assemblage of species seems to have been recently evolved. They exhibit great extremes in color pattern, vestiture and sculpture. They are in many cases widely distributed and abundant. The limits of the species are vague in comparison with the other members of the family and even after a detailed study of the types it is difficult to be certain of the identification of the specimen at hand. This is especially true with the species of *Oxacis* s. str. The speciation problems here will not be fully understood until detailed population studies are made and we learn the biology, the characters of the larvae, and the limits of variation in coloration, vestiture, and sculpture of the species. This will involve synonymizing some species not considered valid (as I have already done in two cases) and describing some new species where they are at present considered as within the limits of the variation of species.

The characters of the genus as a whole are below briefly summarized, and details are reserved for the definition of the subgenera.

Generic features.—Body slender. Head short, antennae inserted with the base approximate to the eyes and the base of the mandibles beneath the eyes. Eyes slightly emarginate only.

Male genitalia.—Median lobe with basal dorsally recurved process; paramere with basal plates and apical lobes; tegminite a well developed lobe; ninth abdominal sternite a plate with lateral margins extending dorsally and with a long basal median apodeme; ninth tergite a simple membranous plate with lateral chitinous rods; eighth abdominal sternite two lobes; ninth tergite a plate, membranous at center.

Distribution.—This genus as here understood is confined to the new world, mainly North and Central America. There are several species described from the Australian region and placed in the genus *Copidita* which may fall in this genus.

KEY TO SUBGENERA

1. Both mandibles distinctly bifid at apex; claws not toothed; median lobe of male genitalia without a sub-basal apodeme ..... *Oxycopis* n. subgen.
   Both mandibles entire (rarely as in *Oxacis falli* almost bifid); claws sometimes toothed; median lobe of male genitalia with or without sub-basal apodeme 2
2. Claws toothed at base; median lobe of male genitalia with a sub-basal apodeme ..... *Paroxacis* n. subgen.
   Claws not toothed at base 3

3. Eyes small, distance behind eyes twice distance in front to base of mandibles*; head very short; mandibles small, curved, sharp; median lobe of male genitalia with sub-basal apodeme ..... *Xanthochroina* Ganglb.
Eyes not small, distance behind eyes equal or less distance in front to base of mandibles*; head short or not; mandibles usually stout, often blunt; median lobes of male genitalia without sub-basal apodeme ..... *Oxacis* s. str.

Subgenus OXACIS sensu stricto

Oxacis LeConte, New Species Col., 1: 165, 1866.—LeConte and Horn, Classif. Col. N. Amer., ed. 2: 405, 1883.—Champion, Biol. Centr.-Amer., Col., (4), 2: 149, 1889.—Horn, Proc. Calif. Acad. Sc., (2), 6: 410, 1896.—Seidl., Naturgesch.-Ins. Deutschl., (5), 2: 815, 1899.

To this subgenus are restricted those species of *Oxacis* sensu lato, which have simple mandibles and simple claws and the median lobe of the male genitalia without a sub-basal apodeme.

Subgeneric diagnosis.—Head usually moderately long; eyes large, oval, slightly emarginate near the insertion of the antennae, distance behind the eyes equal or less the distance in front to base of mandibles; antennae long, each segment slender, elongate; mandibles usually stout, often blunt; apical segment of the maxillary palpi large, variously shaped. Thorax broad, narrower at base, lateral margins sinuate. Legs slender, apical tibial spurs 2-2-2; claws simple. Abdomen with five visible ventral sternites. Color and pubescence variable with the species.

Male genitalia.—Median lobe short, moderately stout, apex blunt; base with short, dorsally recurved process, sub-basal apodeme absent. Paramere with basal plates thin, linear; with apical lobes less than one-half the entire length of the paramere. Tegminite a simple, flat lobe, very lightly chitinized. Ninth abdominal sternite a plate with lateral margins projecting dorsally; apex deeply emarginate, base truncate with long basal median apodeme. Tergite two rods united by membrane. Eighth abdominal sternite two lobes united at base. Tergite a simple plate, arcuate apically and with the center membranous. Setae present on the apex of the tegminite, ninth and eighth abdominal sternite and tergite.

Distribution.—The species recognized in this subgenus are confined to the western and extreme southern states.

KEY TO THE SUBGENUS OXACIS S. STR.

The male genitalia offer no tangible specific characters.
1. Thorax distinctly punctate; area between punctures smooth, or punctures confluent 2
Thorax rugose, or rugose-punctate; area between punctures rough, or punctures irregular 7
2. Thoracic punctures sparse; thorax shiny, almost devoid of pubescence ....*laevicollis* Horn
Thoracic punctures dense, usually closer together than the space between; pubescence dense 3
3. Pubescence of thorax long, coarse white hairs originating from each puncture and obscuring the punctures 4
Pubescence of thorax short, fine white hairs not obscuring the punctation 5

* This character of distance behind the eyes may be obscure in cases where drying has retracted the head slightly into the thorax.

4. Elytra costate ..... *pallida* LeC.
Elytra without costae ..... *sericea* Horn
5. Thorax and elytra not uniformly colored 6
Color uniformly pale fuscous ..... *fragilis* Horn
6. Vestiture moderately long; thorax pale; pale sutural vitta broad, punctures very large, confluent ..... *taeniata* LeC.
Vestiture short, that of the elytra uniformly directed posteriorly; pale sutural vitta narrow, punctures separate ..... *dubiosa* Horn
7. Thorax rugose-punctate, punctures distinct, but area between rough or rugose 8
Thorax rugose, punctures indistinct and merging into each other 10
8. Thoracic punctures usually large, distinct, with a rugose pattern of fine striations between each; color dark 9
Thoracic punctures usually small, indistinct because of the deep rugose sculpture between each; color fuscous without metallic lustre ..... *subfusca* Horn
9. Body piceous with a distinct metallic lustre ..... *falli* Blatch.
Body dark fuscous without metallic lustre ..... *granulata* LeC.
10. Elytra with costae prominent, fuscous in color, and with a fuscous sutural and marginal stripe ..... *floridana* Horn
Elytra without costae, color variable, but at most with sutural and marginal stripes only ..... *cana* LeC.

OXACIS (OXACIS) LAEVICOLLIS Horn

Oxacis laevicollis Horn, Proc. Calif. Acad. Sc., (2) 6: 412, 1896.

This species is one of the few distinctive species of this genus. The shiny thorax and elytra, the shallow punctation and sparse vestiture and the dark elytra with a pale sutural area separate this from the other species in this subgenus.

Lectotype: ♀, Arizona, [ANSP (Horn) type no. 8058].

Head: moderate in length, very sparsely, but distinctly punctate, surface very shiny. Antennae with each segment five times as long as broad. Eyes rather large, elongate oval, slightly emarginate. Mandibles moderate, thin, acute at apex. Maxillary palpi large, apical segment broader, widest near base.

Thorax: notum longer than broad, widest near apex, sides moderately sinuate, surface sparsely but distinctly punctate, very shiny. Sternum rugose. Legs slender, claws simple. Elytra, rugose, vaguely costate.

Abdomen: surface rugose, apical segment evenly arcuate.

Pubescence: head and thorax with extremely fine, extremely short and sparse golden hairs, elytra and abdomen with longer, coarser, denser, whitish hairs.

Color: dark with paler markings; head brown, pale at base; antennae pale-brown; thorax yellowish-brown on notum, pale beneath; legs pale; abdomen dark; elytra dark with suture and margins pale.

Length: 7 mm.

Male.—Cottonwood Springs, Grand Canyon, Arizona, May 1916, (L. N. Gooding), [USNM].

The male agrees with the female in all respects.

Length: 7 mm.

Male genitalia.—The male genitalia agree in all essential respects with the genotype.

Individual variation.—The pale sutural area of the elytra varies among the specimens examined, being moderately broad in some and nearly absent in others. Length: 6-9 mm.

Biology.—On agave blossoms.

Distribution.—Arizona.

Specimens examined.—13: 9 ♂, 4 ♀.

ARIZONA: Cottonwood Springs, Grand Canyon, May 1916, (L. N. Gooding): 9 ♂, 2 ♀ [USNM]; no further data: 2 ♀, [ANSP (Horn), lectotype and paratype].

OXACIS (OXACIS) FRAGILIS Horn

Oxacis fragilis Horn, Proc. Calif. Acad. Sc., (2), 6: 413, 1896.
Type locality: San José del Cabo, Lower California.

The type is unknown to me [type no. 144, California Academy of Science collection]. There is a female from Utah (probably the one mentioned in the original description), in the Academy of Natural Sciences of Philadelphia labeled lectotype no. 8059, supposedly a part of the type series. However, this specimen does not fit Horn's description very well.

The uniform pale coloration, the distinct thoracic punctures and pubescent thorax are characters which serve to separate this species from the others of the group.

Male: Ehrenberg, Yuma Co., Arizona, June 19, 1946 (W. F. Barr) [USNM].

Head: Moderate in length; coarsely, shallowly punctate, the space between punctures smooth. Antennae short, each segment not over three times as long as broad. Eyes large, slightly emarginate near the antennae. Mandibles large, acute. Maxillary palpi with the apical segment cultriform, widest near the base.

Thorax: very slightly longer than broad, widest in front of the middle, punctures coarse, shallow, with space between smooth. Legs slender, claws simple. Elytra without costae, or at most with vague traces; surface finely, sparsely punctate.

Abdomen: with the apical sternite evenly rounded at the apex; surface irregularly, finely punctate.

Pubescence: entirely covered with moderately dense, fine white hairs.

Color: entirely pale fuscous.

Length: 8 mm.

Female.—Same data as male.

The female agrees with the male in all essential respects.

Male genitalia.—No particular difference from the genotype.

Individual variation.—Length: 6-9 mm. Only slight differences in color and punctation observed.

Biology.—Unknown.

Distribution.—Known from Lower California, California, New Mexico, Arizona and Colorado.

Specimens examined.—19: 2 ♂, 6 ♀, 11 sex undetermined.
CALIFORNIA: Indio, June 28, 1937 (A. T. McClay): 1 [McClay]. Palo Verde, Imperial Co., Aug. 20, 1946 (W. F. Barr): 1; Ripley, Riverside Co., July 26, 1946 (Barr & Hurd): 3 [Idaho].
NEW MEXICO: Farmington, July 16, 1933 (K. Maehler): 1 ♀ [AMNH].
ARIZONA: Hope, June 11, 1947 (A. T. McClay): 2 [McClay]. Laguna, June 14, 1940 (W. F. Barr): 1; San Luis, June 15, 1940 (W. F. Barr): 1; Ehrenberg, Yuma Co., June 19, 1946 (W. F. Barr): 1 ♂, 1 ♀ [Idaho]. Phoenix: 2 ♀; Grand Canyon: 1 ♀; Huachuca Mts., July 1905: 1 ♀ [AMNH].
COLORADO: Fruita, July 19, 1919: 1 ♂, 2 [AMNH].

OXACIS (OXACIS) GRANULATA LeConte

Oxacis granulata LeConte, New Species Col., 1: 166, 1866.

This species has short, moderately coarse vestiture, punctures distinct but irregular, and the surface between them rugose; color dark brown to nearly piceous.

Holotype: ♀, Lower California, *no further data*, [MCZ (LeC.) type no. 4799].

Head: short, surface punctate, area between punctures rugose. Antennae with each segment six times as long as broad, slightly expanded apically; apical segment constricted at center. Eyes large, nearly circular, distinctly emarginate. Mandibles thin, small, acute at apex. Maxillary palpi with the apical segment broad, widest near base.

Thorax: notum distinctly longer than broad, expanded apically, sides sinuate, punctate like the head. Sternum rugose. Legs slender, claws simple. Elytra rugose, vaguely costate.

Abdomen with the apical sternite evenly rounded at the apex; surface rugose.

Pubescence: entirely covered with moderately short, recumbent, moderately dense whitish pubescence.

Color: entirely dark brown.

Length: 6 mm.

Male—6 mi. N Triumfo, Lower California, July 15, 1938, (Michelbacher & Ross), [CAS].

The male agrees with the female in all essential respects.

Male genitalia.—No essential difference from the genotype.

Individual variation.—Length: 6-9 mm. Color varies from dark fuscous to nearly piceous; punctation sometimes obscure.

Biology.—Unknown.

Distribution.—Known only from Lower California.

Specimens examined.—10: 3 ♂, 7 ♀.

LOWER CALIFORNIA: *no further data:* 1 ♂, 1 ♀, [MCZ (LeC.) type series]. 20 mi. N. Comondu, July 23, 1938: 1 ♀; Miraflores, July 8, 1938: 1 ♀; 6 mi. N. Triumfo, July 15, 1938: 2 ♂, 3 ♀; Triumfo, July 7, 1938: 1 ♀, (Michelbacher & Ross), [CAS].

OXACIS (OXACIS) PALLIDA (LeConte)

Asclera pallida LeConte, Proc. Acad. Nat. Sc., Philad., 7: 244, 1854.—LeConte, New Species Col., I: 165, 1866, (*Oxacis*).—Horn, Proc. Calif. Acad. Sc., (2), 6: 414, 1896, (*Oxacis*).

Oxacis sororia Horn, Proc. Calif. Acad. Sc., (2), 6: 414, 1896. [Type no. 8061, ♀, and 7 paratypes, ANSP (Horn)]. [New synonymy.]

Type locality: Texas.

Oxacis grisea Horn, Proc. Calif. Acad. Sc., (2), 6: 414, 1896. [Type no. 8060, ♂, ANSP (Horn).] [New synonymy.]

Type locality: Texas.

This species and *O. sericea* are the only two species in this subgenus with the pubescence very coarse and heavy and obscuring the sculpture of the elytra and thorax. It may be readily distinguished from the latter by the presence of distinct elytra costae.

Holotype: ♀?, Texas, [MCZ (LeC.) type no. 4797].

Head: short, especially bent under, surface smooth. Antennae with the apical segment constricted at the center, each segment three and one-half times as long as broad. Eyes small, elongate oval, very slightly emarginate. Mandibles moderately thin, moderately acute at the apex. Maxillary palpi with the apical segment broad, widest near the center.

Thorax: notum slightly longer than broad, surface finely and sparsely punctate, widest at apex, sides sinuate. Legs slender, claws swollen at base. Elytra rugose, costate.

Abdomen: apical sternite evenly rounded, rugose.

Pubescence: body entirely covered with long, dense, coarse white hairs, recumbent, except for a central and two lateral bare areas on the thorax.

Color: pale with a grayish-brown appearance due to pubescence. Head pale testaceous; thorax testaceous with a central and two lateral piceous spots; metasternum piceous; legs testaceous; elytra testaceous with pale costae; abdomen brownish-piceous.

Length: 9 mm.

Allotype: ♂, same data as Holotype.

The male agrees with the female in all essential respects.

Male genitalia.—Agrees with the genotype.

Individual variation.—The color of this species varies from pale to piceous under the powdery appearing coating of coarse hairs. Some specimens lack any thoracic spots or bare areas.

Length: 5-12 mm.

Biology.—One record only of an adult taken on Russian Thistle.

Distribution.—Known from Utah s. to Tex., N. M., Ariz. & Calif.

Specimens examined.—45: 5 ♂, 24 ♀, 16 sex undetermined.

CALIFORNIA. Baker's Field, July 8, 1928: 1 ♂, 3 ♀, [McClay]. Blythe, Riverside Co., Aug. 17, 1946, (P. D. Hurd): 1; Palo Verde, Imperial Co., Aug. 17, 1946, (W. F. Barr): 3 ♀,3; Ripley, Riverside Co., July 26, 1946, (P. D. Hurd & W. F. Barr): 4, [Idaho]. Thermal, Riverside Co., 100 ft. below tide, Aug. 17-18, 1927, (Cornell U. Exp.): 1 ♂, 1 ♀, 1; Lindsay, July 19, 1911, (J. C. Fauve): 1 ♂; Salton Sea, Aug.

19, 1927, (Drake & Andre): 1; [USNM]. Bakersfield, July 8, 1928, (G. Linsley): 5 ♀; Porterville, July 1913: 2 ♀; Yuma: 2 ♀, [CAS].

ARIZONA: Phoenix, Aug. 23, 1936, (D. K. Duncan): 1 ♀, 2; Winstow: 1 ♀; Tempe: 6 ♂, 3 ♀, 8, [USNM]; Winslow, (Wickham): 1, [AMNH]. Gillespie's Dam, Maricopa Co., Aug. 19, 1924, (E. P. VanDuzee) 5 ♀, 5, [CAS]; *no further data*, (Wickham): 1 ♂, 1, [USNM].

NEW MEXICO: State College, Aug. 30, (Merrili): 1 ♀, [USNM]. Mesquite near Mesille Park, July 12, 1917: 1 ♀, [AMNH]; same data: 1 ♂, 7 ♀, [CU].

TEXAS: Ft. Hancock, June 16, 1947, (A. T. McClay); 1 ♂, 1 ♀, [McClay]. Castalon: 1 ♀, [Alab.]. El Paso: 3 ♀, 1; Kingston, (C. T. Reed): 1 ♀, [CU]. El Paso, June 25, 1946, (E. P. VanDuzee): 1 ♀, [CAS]; El Paso, July, (Wickham): 1 ♀, [USNM].

UTAH: Iosepa, July 30, 1932, (G. F. Knowlton & M. J. Janes): 1 ♂; Grantiville, July 17, 1930, (G. K. Knowlton): 1 ♀, [USNM]. St. George: 3 ♀, [AMNH]; St. George, July, (Wickham): 1 ♀, 3, [CNHM].

NO DATA: 1 ♂, 1 ♀, [MCZ (LeC.) type series]. 1 ♀, 4, [CU].

OXACIS (OXACIS) FALLI Blatchley

Oxacis falli Blatchley, Can. Ent., 60: 63, 1928.

The type of this species has been seen by me, and I have also studied seventeen specimens which agree perfectly with the type and appear to form quite a distinct species of *Oxacis*. The following descripiton is based on this material. The size is small; the color metallic dark blue; the punctation coarse, punctures moderately large, distinct; the vestiture is coarse, moderately short, white hairs. The presence of a small internal sub-basal apodeme in the male genitalia and the almost bifid mandibles indicate that this species is an intergrade, combining somewhat the characters of several of the subgenera of this genus.

Holotype: ♂, Florida, Cape Sable, April 26, 1927 (W. S. Blatchley) [Purdue U].

Head short, surface coarsely, sparsely punctate. Antennae with each segment four and one-half times as long as broad, slightly expanded apically. Eyes large, nearly circular, slightly emarginate. Mandibles thin and almost bifid at apex. Maxillary palpi with the apical segment triangular, widest near base.

Thorax: notum longer than broad, widest at apical third, sides sinuate, surface punctate, punctures smaller and closer than those on head. Sternum rugose. Legs slender, claws simple. Elytra with hardly a trace of costae, finely rugose.

Abdomen finely rugose, apical segment evenly arcuate.

Pubescence: long, coarse, sparse whitish hairs covering entire body.

Color: head metallic bluish-brown with front and mouthparts paler; antennae brownish; thorax metallic bluish-brown; legs brownish; elytra metallic bluish-brown with suture and narrow margins paler. Abdomen metallic bluish-brown.

Length: 8 mm.

Male genitalia.—The male genitalia agree with the genotype except that the median lobe has a small sub-basal apodeme internally and the apex has a noticeable knob.

Female.—Summerland Keys, Fla., July 24, 1940, (J. C. Bradley) [CU].

The female agrees with the male.

Individual variation.—The elytra often uniformly metallic bluish-brown without pale sutural and marginal stripe.

Length: 5-8 mm.

Biology.—Blatchley states that the two type specimens were taken April 16, 1927, by sweeping a fleshy crucifer on the beach near Cape Sable, Florida.

Distribution.—Known only from Florida.

Specimens examined.—17: 8 ♂, 8 ♀, 1 sex undetermined.

FLORIDA: Summerland Keys, July 24, 1940, (J. C. Bradley): 4 ♂, 4 ♀; Englewood, Mar. 9, 1944, (J. G. Needham): 1 ♀; Sanibel Island, April 26, 1927, (M. D. Leonard): 2 ♂, [CU]. Miami, June 4, 1937: 1 ♂, [CNHM]. *No further data:* 3 ♀, [CAS]. Coral Gables, June 26, 1939: 1, [McClay]. Cape Sable, April 16, 1927, (W. S. Blatchley [Purdue U] (Paratype): 1 ♂.

OXACIS (OXACIS) FLORIDANA Horn

Oxacis floridana Horn, Proc. Calif. Acad. Sc., (2), 6: 415, 1896, [Fla.].

This species may be identified by the orange head, dark antennae, orange thorax with a broad median and broad lateral piceous stripes and the elytra dark fuscous with distinct pale costae and a narrow sutural and marginal stripe.

Holotype: ♀, Florida, [ANSP (Horn) type no. 8062].

Head moderate, punctate, punctures distinct, not closely set; gula smooth. Antennae with apical segment uniform throughout, not ringed or constricted at center; each segment elongate, seven times as long as broad. Eyes large, semi-circular, slightly emarginate. Mandibles simple, acute at tip. Maxillary palpi with the apical segment widest at base.

Thorax: notum longer than wide; surface punctate, punctures like those of the head. Sternum rugose. Legs slender, claws simple. Elytra each with three prominent costae, surface rugose. Abdomen with the apical segment slightly emarginate.

Pubescence: fine, moderately long, white; sparse on head and thorax, dense on costae, forming stripes.

Color: piceous with orange markings. Head, antennae, legs, elytra and abdomen piceous; thorax with the sternum piceous.

Length: 12 mm.

Male.—Lucedale, Mississippi, May 12, 1929, (H. Dietrich), [CU].

The male agrees with the female in all essential details. The male genitalia show no appreciable difference from that of the genotype.

Individual variation.—Length: 7-12 mm. Color constant in series studied.

Biology.—Unknown.

Distribution.—Known only from Florida and Mississippi.

Specimens examined.—45: 7 ♂, 18 ♀, 20 sex undetermined.

FLORIDA: *No further data:* 1 ♀, [ANSP, (Horn) type].

MISSISSIPPI: Lucedale, May 12, 1929: 5 ♂, 6 ♀, 5; June 20, 1929, 1 ♂, 3 ♀, 3; May 26, 1930: 1 ♂, 4 ♀, 1; May 28, 1930: 1 ♀, 7; May 17, 1931: 3 ♀, 2; June 16, 1932: 2, (H. Dietrich), [CU].

OXACIS (OXACIS) CANA (LeConte)

Asclera cana LeConte, Proc. Acad. Nat. Sc., Philadel. 7: 225, 1854.—LeConte, New Species Col., 1: 165, 1866, (*Oxacis*).—Horn, Proc. Calif. Acad. Sc., (2), 6: 416, 1896, (*Oxacis*).

This species is perhaps the most variable of the entire family; its exact limitations are at present obscure. For this definition I have regarded only those specimens having the punctation obscure and rugose, the mandibles large, the apex convergent, deflected and blunt, and lacking elytral costae. This at best is an arbitrary limitation. The coloration, vestiture, sculpture and size are extremely variable. The male genitalia offer no clues to identification and the biology is unknown. There are many cases where it is necessary to reject or accept a specimen as belonging in this species merely because it was or was not collected in the same series with the typical form. The type series is extremely variable and I very much doubt if it constitutes a single species.

Holotype: ♀, Arizona, [MCZ (LeC.) type no. 4796].

Head: moderately long; surface rugose. Antennae with each segment linear, five times as long as broad; inserted between the eyes and the base of the mandibles; apical segment abruptly narrowed at center. Eyes large, nearly circular, protruding, slightly emarginate near insertion of the antennae. Mandibles long, stout, apex blunt, convergent, ventrally deflected. Maxillary palpi with the apical segment cultriform, widest near base.

Thorax: notum slightly longer than broad, apex wide, abruptly narrowing at the center; surface rugose-punctate, punctures indefinite. Sternum with the surface finely rugose. Legs slender, claws basally enlarged. Elytra with the surface rugose, without costae.

Abdomen with the surface finely rugose, apical segment evenly arcuate at the apex.

Pubescence: entirely covered with moderately long, dense, coarse white recumbent hairs.

Color: orange with piceous markings. Head orange with a vague central piceous spot, mouthparts piceous. Antennae piceous. Thorax orange with two lateral and one median small piceous spot. Legs with the basal half of the femora orange, apical half piceous; tibia basally piceous. Elytra dark, fuscous-piceous, margins and suture narrowly pale.

Length: 11 mm.

Male.—♂, Kits Peak, Rincon Baboquivari Mts., Arizona, Aug. 1-4, 1916, [AMNH].

The male agrees with the female in all essential respects.

Male genitalia.—(Pl. VII, fig. 22). Median lobe short, moderately stout, apex blunt; base with short, dorsally recurved process, sub-basal apodeme absent. Paramere with basal plates thin, linear and with apical lobes less than one-half the entire length of the paramere. Ninth abdominal sternite a plate with lateral margins projecting dorsally; apex deeply emarginate, base truncate with long basal apodeme. Tergite two rods united by

membrane. Eighth abdominal sternite two lobes united at base. Tergite a simple plate, arcuate apically and with the center membranous. Setae present on the apex of the tegminite, ninth and eighth abdominal sternite and tergite.

Individual variation.—Thoracic median piceous spot present in the type varies in other specimens to a median stripe. Elytra varies from piceous with narrow sutural and marginal stripes to orange-fuscous. Abdominal sternite piceous to fuscous. Antennae piceous to pale.

Length 8-12 mm.

Biology.—Adults reported taken at lights and on *Opuntia* and *Monarda.*

Distribution.—This species as here defined and limited is known from Kentucky and Missouri southward through Texas and Arizona.

Specimens examined.—100: 14 ♂, 38 ♀, 48 sex undetermined.—I have not recorded each specimen which is in the LeConte series, or the Horn series. I do not believe them to be all the same species. The type series is very variable. The preceding description is based on the type specimen as indicated, and the following specimens recorded as selected as being in close agreement with the type; all others are excluded which may or may not be the same species. The limitation of the species is as yet unknown to me and it may prove with further study to be far more varied than here indicated.

KENTUCKY: Henderson, June 20, 1926, (M. Y. Marshall): 1 ♀ 2, [CU].

MISSOURI: Waynesville, July 7, 1940, (M. Gordon): 1, [CU].

ARKANSAS: Benton Co., Aug. 25, 1932, (S. A. Summerland): 2, [McClay]. Hope, June 1932: 6 ♂, 3 ♀, [CU].

OKLAHOMA: South McAlester, (Wickham): 2 ♂, 1♀, [USNM].

TEXAS: Victoria, July 16, 1916, (J. D. Mitchell): 1 ♀, 2; Cyp Mills, (Chittenden): ! ♀, 1; Hondo, (J. D. Mitchell): 1 ♀; Devils River, May 6, 1907, (Bishop & Pratt): 1 ♀, 2; Sabina, May 1910, (F. C. Pratt): 1 ♀; Weatherford, June 9, 1908, (C. R. Jones): 1 ♀; Houston, June 17, 1895: 1 ♀; San Antonio, June 22, 1895: 2 ♀, 3; New Brownfels, June 27, 1895: 3; Presideo, June 23, 1940: 3 ♂, 11 ♀, 1, (Custom House lights), [USNM]. Wharton, June 24, 1917: 1; Victoria, June 24, 1917: 1 ♀; Edinburg, (S. Mulaik): 2; Hearne, Aug. 24, 1917, (E. L. Diven): 1; Grandview, July 6, 1917, (E. L. Diven): 1; Vraede, May 18, 1918, (J. C. Bradley): 1 ♀, 10; Richmond, Bazos River, June 22, 1917: 1 ♀; May 29, 1918: 1; Wharton, June 24, 1917, (Cornell U. Exp.): 1; Dallas, July 1, 1917, (E. L. Diven): 1; Kingsville, (C. L. Reed): 2 ♀, 2, [CU]. Richmond, Fort Bend, June 22, 1917: 1 ♀, [AMNH]. *No further data:* 2 ♀, [AMNH]. 3, [USNM].

ARIZONA: Glove, July 21, 1935, (Parker): 1 ♀, 3, [Mackenzie]. Camp Verde, Aug. 9, 1933, (K. Maehler): 1 ♀; Black Dike, Prospect Sierritas, July 26, 1916: 1 ♀, 1; Nogales, (Chas. Palm): 1 ♂, 2 ♀; Comobabi Mts., Aug. 9-10, 1915: 1 ♂; Kits Peak, Rincon, Baboquivari Mts., Aug. 1-4, 1916: 1 ♂, [AMNH]. Pinal Mts., Gila Co., (D. K. Duncan): 1 ♀, 1; [McClay]. Palmerlee, (H. A. Kaeber): 2, [USNM].

NO DATA: 1 ♀, [CNHM].

OXACIS (OXACIS) TAENIATA (LeConte)

Asclera taeniata LeConte, Proc. Acad. Nat. Sc., Philad., 7: 21, 1854.—LeConte, New Species Col., 1: 165, 1866 (Oxacis).—Horn, Proc. Calif. Acad. Sc., (2), 6: 416, 1896, (Oxacis).

The relatively long vestiture, usually broad sutural vitta, and particularly the large, distinct, confluent thoracic punctures limit this species.

Holotype: ♀, Southern states, (orange disc) [MCZ (LeC.) type no. 4798].

Head moderately long, surface coarsely and closely punctate, gula smooth. Antennae [each broken in type series], with each segment four times as long as broad, slightly expanded apically. Eyes large, oval, very slightly emarginate. Mandibles acute at apex, thin. Maxillary palpi with the apical segment broad, widest sub-center, nearest base.

Thorax: notum longer than broad, sides sinuate, widest apically, surface with large, distinct, confluent punctures. Sternum finely rugose. Legs slender, claws simple. Elytra rugose, without trace of costae.

Abdomen: finely rugose, apical sternite evenly rounded.

Pubescence: moderately dense, moderately long, fine, whitish-yellow.

Color: fuscous with testaceous markings. Head and abdomen fuscous. Antennae testaceous. Thorax testaceous with sides fuscous. Legs pale. Elytra fuscous with broad sutural and narrow marginal pale stripe.

Length: 9 mm.

Allotype: ♂, South Carolina, [MCZ (LeC.)].

The male agrees with the female in all essential details.

Male genitalia.—Agrees with that of the genotype.

Individual variation.—The sutural pale vitta varies considerably in the material examined.

Biology.—Unknown.

Distribution.—Horn included specimens from Texas which are probably *Oxacis cana* (LeC.). The LeConte material is from South Carolina, south through Florida. The additional material examined is from the coast of North Carolina, Georgia and Florida.

Specimens examined.—78: 38 ♂, 19 ♀, 21 sex undetermined.

NORTH CAROLINA: Cape Fear, Smith Island, September 1, 1934 (H. S. Barber): 2 ♂, 1 ♀, [USNM]. Kill Devil Hills, July 6-21, 1950 (K. V. Krombein): 7 ♂, 5 ♀, [Author].

SOUTH CAROLINA: *no further data:* 1 ♂, [MCZ (LeC.)].

GEORGIA: Savannah: 5, [Reading]; 1 ♂, 1 ♀ [USNM]. Tybee Island: 1, [Reading]: 2 ♂, 2 ♀, [USNM]. Tybee Beach, July 20, 1905: 2, [Alabama]. *No further data:* [MCZ (LeC.)]

FLORIDA: Miami, June 9, 1938, (H. F. Strohecker): 8 ♂, 2 ♀, 1, [Strohecker]. Miami Beach, April 1922, (Bailey): 1 ♂, 1 ♀, [USNM]. Capron: 1 ♀, 1 [MCZ (LeC.)]. Kissimmee (Chas. Palm): 1 ♂, 1; Mayport: 1 ♂, [AMNH]. Palm Beach Apr. 7-10, 1925): 1 ♂, [CU]. Lake Worth, (Hubbard & Schwarz): 1 ♀; Biscayne, (Hubbard & Schwarz): 1 ♂, 1 ♀; New Smyrna, (Hubbard & Schwarz): 2 ♂, [USNM]. *No further data:* 1 ♀ [MCZ (LeC.)]; 3 ♂, 2 ♀, [USNM]; 4, [CU]; (F. Psota): 6 ♂, [CNHM].

SOUTHERN STATES: *no further data:* 1 ♀, [type], 1. [MCZ (LeC.)].

NO DATA: 1 ♂, 1. [MCZ (LeC.)].

OXACIS (OXACIS) DUBIOSA Horn

Oxacis dubiosa Horn, Proc. Calif. Acad. Sc., (2), 6: 418, 1896.

The type specimen is in the California Academy of Science collection, [type no. 150, and paratypes nos. 148, 149, 151, and 152 from San José del Cabo, Lower California, except no. 152 which is from Sierra San Lazaro, Lower California], and one specimen called "cotype" from San José del Cabo in the U. S. National Museum Collection.

The short, regular pubescence, especially of the elytra readily distinguishes this species from the others of the subgenus. The type series, of which I have seen only one, has a narrow pale sutural stripe.

Paratype: ♀, San Jose del Cabo, Lower California (Fuchs) [USNM no. 59366].

Head short, surface coarsely, closely punctate, gula smooth. Antennae with each segment four times as long as broad at the center, slightly expanded at the apex. Eyes large, oval, slightly, but definitely emarginate near antennae. Mandibles small, blunt at apex. Maxillary palpi with apical segment triangular, widest at center.

Thorax as broad at the widest point as long, widest apically, sides strongly sinuate, surface coarsely punctate, interval between punctures smooth, a hair arising from each puncture. Sternum less coarsely punctate. Legs slender, claws simple. Elytra rugose-punctate, punctures indistinct.

Abdomen finely rugose.

Pubescence short, rather coarse, longer on notum than on the elytra, that of the elytra regularly arranged and directed posteriorly, almost scale-like.

Color: dark fuscous, elytra with pale, narrow sutural vitta; thorax paler than elytra, front of head, front coxae and basal half of femora pale.

Length: 5 mm.

Male genitalia.—Unknown.

Biology.—Unknown.

Distribution.—Known only from the southern part of Baja California, from the type series only.

OXACIS (OXACIS) SERICEA Horn

Oxacis sericea Horn, Trans. Amer. Ent. Soc., 3: 89, 1870.—Horn, Proc. Calif. Acad Sc., (2), 6: 418, 1896.

This species and *O. pallida* are the only two of this subgenus with long, coarse, white pubescence which entirely covers the body, obscuring the sculpturing. This species is distinct from *O. pallida* by lacking elytra costae.

Lectotype: ♂, Inyo Co., California, [ANSP (Horn) type no. 8069].

Head short, surface rugose. Antennae with each segment five times as long as broad. Eyes small, protruding, slightly emarginate. Mandibles short, acute. Maxillary palpi with the apical segment slender, widest near the apex.

Thorax: notum very slightly longer than broad, surface rugose. Sternum with the surface rugose. Legs slender, claws simple. Elytra with the surface rugose, wtihout costae.

Abdomen rugose.

Pubescence: entirely covered with dense, coarse, long, whitish hairs.

Color: fuscous, antennae and legs pale.

Length: 7 mm.

Male genitalia.—Agree essentially with the genotype description.

Female.—Shoshone, California, Aug. 8, 1919, [ANSP].

The female agrees with the male in all essential details.

Individual variation.—Length: 5-8 mm. No other important variation observed.

Biology.—Unknown.

Distribution.—Known from Oregon and Idaho south through Nevada, California to Texas.

Specimens examined.—52: 10 ♂, 11 ♀, 31 sex undetermined.

OREGON: Nyssa, June 29, 1938, (H. E. Wallace): 1 ♂, [USNM]. Nyssa, alt. 2,179 ft., June 16, 1926, (R. W. Haegele): 2 ♂, 2 ♀, [Idaho].

IDAHO: Twin Falls, Aug. 31, 1927, (J. E. Rommey): 1 ♀, [USNM]. Parma, alt. 2,224 ft., July 18, 1929: 1 ♀, 1, [AMNH]; *same data:* 1 ♀ [Idaho].

CALIFORNIA: Inyo Co., 1 ♂, (type): *no further data:* 1 ♀, 1, [ANSP (Horn) type series]. Ballarat, Paramint Valley, (R. & H.), alt. 1,067 ft., Sept. 8, 1922: 6; Shoshone, Aug. 8, 1919: 1 ♀, 2, [ANSP]; Palo Verde, Imperio Co., Aug. 17, 1946, (W. F. Barr): 1 ♀, [Idaho]. Thermal, Riverside Co., 100 ft. below tide, Aug. 17-18, 1927: 1 ♂, 2 ♀, 3; Owens River: 1 ♂, [CU]. Bishop, July 27, 1940, (G. P. Mackenzie): 1, [Mackenzie].

NEVADA: Beatty, (R. & H.), Aug. 9-12, 1919: 9; Fairbanks Ranch, 2,300 ft., (R. & H.), Ash Meadows, Aug. 23, 1919: 2, [ANSP]. Nixon, June 20, 1927, (E. P. Van-Duzee): 4 ♂, 1 ♀, [CAS]. Reno, June 29, 1940, (Ira LaRiver): 1, [Idaho]; *no further data:* 1, [AMNH].

TEXAS: Brownsville, July, (Wickham): 1, [AMNH].

NO DATA: 1, [MCZ (LeC.) with type no. 8159, *but not type*].

OXACIS (OXACIS) SUBFUSCA Horn

Oxacis subfusca Horn, Proc. Calif. Acad. Sc., (2), 6: 419, 1896.

This entirely fuscous species has small, indistinct thoracic punctures, except for a small central area of the thorax where they are larger and more distinct; the area between punctures is rugose. The pubescence is short, recumbent, moderately coarse, whitish, giving the entire insect a powdery appearance.

Lectotype: ♀, Arizona, [ANSP (Horn) type no. 8065].

Head: moderately short, surface coarsely rugose. Antennae with each segment five times as long as broad, apex somewhat broader, apical segment very slightly ringed at center. Eyes oval, large, protruding, slightly emarginate at insertion of antennae. Mandibles stout, short, apex blunt. Maxillary palpi with the apical segment largest, widest near base.

Thorax: distinctly longer than broad; surface rugose-punctate. Sternum rugose. Legs slender, claws simple. Elytra finely rugose, without costae.

Abdomen finely rugose, apex of apical sternite evenly arcuate.

Pubescence: short, moderately coarse, recumbent, white.

Color: entirely fuscous with whitish tinge because of pubescence.

Length: 7 mm.

Male.—Phoenix Arizona, [AMNH].

The male agrees with the female in all essential respects, except that the abdomen is very slightly emarginate.

Male genitalia.—Agrees with the description of the genotype.

Individual variation.—Slight.

Length: 6-9 mm.

Biology.—Adults collected at lights.

Distribution.—Known only from Arizona, New Mexico and Utah.

Specimens examined.—33: 16 ♂, 10 ♀, 7 sex undetermined.

ARIZONA: Phoenix, (Chas. Palm): 1 ♂; Grand Canyon, Supai, 3,500 ft. alt., (Havaiser Canyon), Aug. 3, 1934, (D. Rockefeller): 9 ♂, 6 ♀, 5; *same data,* (E. L. Bell): 2 ♂, 1 ♀, 1; *same data,* (F. E. Lutz): 1 ♀, [AMNH]. Tucson, July 14, 1932, (F. E. Parker): 1 ♂, [CU]. *No further data:* 2 ♀, [ANSP (Horn) types].

NEW MEXICO: Farmington, July 16, 1933, (K. Maehler): 1, [AMNH].

UTAH: Zion Canyon, July 6, 1924, (W. W. Henderson): 2 ♂, [USNM].

NO DATA: (Vasco M. Tanner): 1 ♂, [USNM].

Oxycopis new subgenus

Genotype: Necydalis notoxoides Fabricius. [Present designation.]

Five species included in the genus Copidita by Horn and four species here described comprise this subgenus as here defined. The mandibles are both bifid at the apex and the median lobe of the male genitalia lacks a sub-basal apodeme.

Subgeneric diagnosis.—Head moderate; antennae eleven segmented in both sexes, each segment elongate, linear; mandibles usually thin, straight, convergent apically and apex bifid; apical segment of the maxillary palpi large, triangular; eyes large, oval and very slightly emarginate. Thorax broad, legs slender, apical tibial spurs 2-2-2, claws simple. Abdomen with five visible ventral segments. No apparent sexual dimorphism.

Male genitalia.—Median lobe short, stout, apex blunt; base with stout, dorsally recurved process, without sub-basal apodeme. Paramere with basal plates which project posteriorly-dorsally; apical lobes short, apex of each lobe blunt. Tegminite a short, linear plate, apex slightly expanded, arcuate. Ninth abdominal sternite various, usually a plate emarginate anteriorly, V-shaped basally, with a single basal median process. Tergite two rods united at the center for the entire length by membrane. Eighth abdominal sternite two lobes. Tergite a simple plate, lateral margins heavily chitinized, center membranous.

Distribution.—Throughout the United States.

KEY TO THE SPECIES

1. Last joint of maxillary palpus widest near apex 2
   Last joint of maxillary palpus widest near base 3
2. Elytra with costae prominent, marked with denser white hairs, ... *fuliginosa* LeC.
   Elytra without prominent costae; vestiture short, golden ..... *mariae* n. sp.
3. Elytra with well marked costae; white hairs on costae denser, giving appearance of white stripes ..... *luteostriata* n. sp.

Costae of elytra obscure; elytra without white stripes 4
4. Thorax orange; elytra dark 5
Thorax and elytra of different color combination 8
5. Elytra metallic green ..... *mcdonaldi* n. sp.
Elytra piceous 6
6. Elytra with narrow sutural stripe testaceous ..... *mimetica* Horn
Elytra immaculate 7
7. Thorax immaculate ..... *thoracica* Fab.
Thorax with two basal spots ..... *notoxoides* Fab.
8. Elytra each with a broad median piceous stripe; thorax with broad lateral stripes ..... *dietrichi* n. sp.
Elytra with narrow marginal stripe fusco-piceous and thorax with lateral spots or appearance varying to entirely piceous; 9-12 mm ..... *suturalis* Horn

KEY TO MALES

Oxacis (Oxycopis) luteostriata n. sp. is known from ♀♀ only.

1. Tegminite broad throughout, nearly 1/4 as wide as long 2
Tegminite narrow at most expanded at apex, or obscure 3
2. Apex of tegminite arcuate; apex of median lobe stout; parameres with base stout, emarginate 1/3 entire length ..... *notoxoides* Fab.
Apex of tegminite truncate; apex of median lobe somewhat expanded; base of parameres not stout, emarginate less than 1/3 entire length ..... *thoracica* Fab.
3. Tegminite expanded at apex 4
Tegminite narrow throughout or obscure, almost membranous 6
4. Median lobe narrower at apex, curved ..... *mimetica* Horn
Median lobe stout at apex, blunt 5
5. Apex of median lobe somewhat narrower than base; lobes of parameres 1/3 entire length ..... *fuliginosa* LeC.
Apex of median lobe as broad as base; lobes of parameres more than 1/3 entire length ..... *mariae* n. sp.
6. Tegminite entirely membranous, obscure 7
Tegminite nearly membranous, distinct ..... *mcdonaldi* n. sp.
7. Apex of median lobe narrow and curved, narrow portion less than 1/8 entire length; apex of ninth tergite not deflected ..... *suturalis* Horn
Apex of median lobe long and narrow, 1/8 entire length; apex of ninth tergite ventrally deflected ..... *dietrichi* n. sp.

OXACIS (OXYCOPIS) NOTOXOIDES (Fabricius)

Necydalis notoxoides Fabricius, Syst. El., 2: 369, 1801.—Haldem., Journ. Acad. Nat. Sc., Philad., (2), 1: 96, 1848, (*Asclera*).—Horn, Proc. Calif. Acad. Sc., (2), 6: 400, 1896, (*Copidita*).

Type locality: Carolina.

The two sub-medial, basal piceous spots on the otherwise orange notum, and the piceous elytra are characters which serve to distinguish this species from the other members of the subgenus.

Male.—Raleigh, N. C., June 20, 1906, (R. S. Wogium), [USNM].

Head: only slightly longer than broad at eyes; surface rugose, except for gular region. Antennae with each segment somewhat enlarged apically. Apical segment of antennae not ringed at center, each segment about five times as long as broad. Eyes small, oval, only slightly protruding. Both mandibles bifid at the apex. Maxillary palpi with the apical segment cultriform, widest near the base.

Thorax: notum as broad as long, widest anteriorly, sides sinuate, surface moderately rugose. Sternum moderately rugose. Legs slender, claws simple. Elytra with costae obscure, surface rugose.

Abdomen with the apical sternite evenly arcuate.

Pubescence: entire insect except the gular region covered with very fine, moderately sparse, brownish, short vestiture.

Color: Black with orange markings. Antennae, legs, elytra and abdomen black; head black with mouth-parts testaceous-piceous; thorax orange with two moderately large, sub-medial basal spots and two apical spots of similar size and position. Spots, piceous, separated by a distance equal to their width.

Length: 9 mm.

Male genitalia.—(Pl. VII, fig. 23). Median lobe short, stout, apex blunt; base with a short, broad, dorsally recurved process. Paramere with basal plates broad, dorsally projecting, base deeply emarginate; apical lobes short, less than one-third the entire length of the paramere, apex of lobes convergent, blunt. Tegminite a simple, flat, elongate plate, apex arcuate. Ninth abdominal sternite two rods, apically expanded and united by membrane. Tergite two rods united by membrane. Eighth abdominal sternite two flat lobes united by membrane. Tergite a simple plate, heavily chitinized at margin, center membranous. Setae short, on apex of tegminite, lobes of paramere, and ninth and eighth abdominal sternite and tergite.

Female.—Beaumont, Mississippi, May 6, 1930, (H. Dietrich), [CU].

The female agrees with the male in all essential respects.

Length: 10 mm.

Individual variation.—The punctation and vestiture constant. The anterior sub-medial spots are often lacking.

Length: 6-10 mm.

Biology.—Adults collected on Dogbane, *Apocynum*, and Summer Savory, (*Sateria hortensis*).

Distribution.—Known from New Jersey south through Florida, west to Texas and Arkansas.

Specimens examined.—127: 11 ♂, 30 ♀, 86 sex undetermined.

NEW JERSEY: Lakehurst, July 26, 1914, (F. M. Schott): 1; Lakehurst: 2; Snake Hill, Hudson Co., 1, [AMNH]. Newark: 1, [CNHM]. Lakehurst: 1 ♀; Malaga, July 20, 1907: 2; Hammonton: 2 ♂, [USNM]. Westville: 1; Atoo: 1, [RPM]. *No further data:* 1 ♂, [Author]. [Specimens from N. J. also in Horn Coll., ANSP].

PENNSYLVANIA: Lingleston: 1, [RPM]. *No further data:* (Hubbard & Schwarz): 1 ♀, [USNM].

MARYLAND: Lloyds, Dorchester Co., July 10, 1907, (H. S. Barber): 2; St. George Island, June 28, 1930, (H. S. Barber): 1 ♀; Piney Pt., 2.3 mi. E., July 12, 1931, (H. S. Barber): 1 ♂; [USNM].

VIRGINIA: Ft. Eustis, 1941, (H. Miller): 1, [CU]. Ft. Monroe, (Hubbard & Schwarz): 1 ♀; *no further data:* June 8-11, 1905, (L. Drummond): 2 ♀, 1; [USNM].

NORTH CAROLINA: Raleigh, June 20, 1906, (R. S. Wogium): 1, [USNM]; *no further data:* 2 ♀, [MCZ (LeC.)].

SOUTH CAROLINA: Summerville, Dorchester Co., June 18, 1943, (B. Malkin): 3 ♂, [Malkin]. Charleston, May 16, 1937, (P. W. Fattig): 1, [Alab.]. [Also specimens in Horn coll., ANSP].

GEORGIA: Ft. Valley, July 6, 1938: 1; Thomasville, May 16, 1938, (P. W. Fattig): 1, [USNM]. Savannah, May 19, 1927: 1 ♂, 1 ♀; Billy's Island, Okefenokee Swamp, July 1912: 1 ♀, 1; Spring Creek, May 18-21, 1916, (J. C. Bradley): 1, [CU]. *No further data:* 1 ♂, [MCZ (LeC.)]. [Also specimens in Horn Coll. ANSP].

FLORIDA: Enterprise: 1 ♂, 1 ♀, 1; Jacksonville: 1 ♀; Stone Island: 1, [RPM]. Baldwin, June 1: 1, Capron: 1, [MCZ LeC.)]. Kissimmee: 1; Jacksonville: 1; Crescent City, April 19, 1908, (VanDuzee): 6; Sanford, April 25, 1908, (VanDuzee): 1; Clearwater, April 21, 1908, (VanDuzee): 1; N. of Olner, Osceola Co., March 27, 1938, (W. J. Gertsch): 1, [AMNH]. *No further data:* 1, [CNHM]; 7, 1 ♀, [USNM].

ALABAMA: Selina, June 1923, (F. B. Bottlen): 2, [ANSP]; Spring Hill, May 24, 1914, (H. P. Löding): 1 ♀, 1; Port, May 10, 1914: 2 ♀, 2; Spring Hill, June 25, 1909, (H. P. Löding): 3 ♀, 1; Mt. Vernon, June 17, 1917, (H. P. Löding): 1 ♀; Mobile, June 5, 1912, (H. P. Löding): 1 ♀, 1, [Alab.]. Russelville, June 28, 1941, (J. N. Belkin): 1 ♀, [Author].

MISSISSIPPI: Waveland, May 25, 1892: 4, [USNM]. Perkinston, May 14, 1930, (H. Dietrich): 2 ♀; Beaumont, May 6, 1930, (H. Dietrich): 1 ♀; Richton, May 21, 1931, (H. Dietrich): 1 ♀, [CU].

LOUISIANA: Pearl River, June 4, 1893: 9; New Orleans, June 13: 2 ♀, 2; Covington, May 28: 1 ♂, 3; [USNM]. Tallulah, June 1933, (J. C. Clark): 1 ♂, 1 ♀, [Author]. Loganspoint, June 6, 1906, (W. D. Pierce): 3, [USNM].

TEXAS: Trinity, June 6, 1906, (F. C. Bishopp): 1, [USNM]. *No further data:* 1, MCZ [(LeC.)].

ARKANSAS: Hot Springs, June 20, 1934, (J. N. Knull): 2, [OSU]. Hope, 1925: 1, [CU].

SOUTHERN STATES: *no further data:* 2 ♀, [MCZ LeC.)].

NO DATAS 2 ♀, 6, [CU]. 1 ♀, [Alab.]

OXACIS (OXYCOPIS) THORACICA (Fabricius)

Necydalis thoracica Fabricius, Syst. El., 2: 370, 1801.—Haldem., Journ. Acad. Nat. Sc., Philad., (2), 1: 97, 1848, (*Asclera*).—LeConte, New Species Col., 1: 165, 1866, (Copidita).—Horn, Proc. Calif. Acad. Sc., (2), 6: 400, 1896, (Copodita).

Type locality: Carolina.

Oedemera fraxini Say, Journ. Acad. Nat. Sc., Philad. 3: 272, 1823 [U. S.].—LeConte, Comp. Writ. T. Say, vol. 2, p. 161, 1859, [first placed as syn. of *thoracica* Fab.].—Horn, Proc. Calif. Acad. Sc., (2), 6: 400, 1896, [syn. *thoracica* Fab.].

Type locality: United States.

This species is very similar to the preceding except that the basal thoracic spots are lacking, and the lobes of the paramere are shorter.

Male.—Southern Pines, N.C., June 6, 1906, [USNM].

Head short, surface rugose-punctate. Antennae with the apical segment very slightly ringed at the center. Eyes large, oval, moderately projecting, very slightly emarginate. Both mandibles bifid at the tip. Maxillary palpi with the apical segment cultriform, widest at base.

Thorax: notum slightly longer than broad, widest at apex, sides sinuate; surface moderately rugose. Sternum rugose. Legs slender, claws simple. Elytra rugose, costae obscure.

Abdomen with the apical sternite evenly rounded.

Pubescence: entire insect except gula clothed in moderately dense, fine white pubescence which is relatively long and coarse on the elytra.

Color: black with thorax orange.

Length: 7 mm.

Male genitalia.—(Pl. VII, fig. 24). Median lobe short, stout, apex with a slight enlargement; base with a short, broad, dorsally recurved process. Paramere with basal plate moderately broad, dorsally projecting; base emarginate less than one-third entire length; apical lobes moderately long, slightly more than one-third entire length of the paramere, lobes convergent, apex blunt. Tegminite a simple, flat, elongate plate, apex slightly expanded and truncate. Ninth abdominal sternite two contiguous rods, apically expanded and united by membrane. Tergite two rods united by membrane, apically convergent. Eighth abdominal sternite two lobes, united at the base. Tergite a simple plate, heavily chitinized at margin, center membranous. Setae short, at apex of paramere lobes, tegminite and ninth and eighth sternite and tergite.

Female.—Lucedale, Mississippi, May 15, 1929, (H. Dietrich), [CU].

The female agrees with the male in all essential respects.

Length: 9 mm.

Individual variation.—The only apparent variation in the specimens examined is the length, varying from 6 to 9 mm.

Biology.—Reported on flowers of Sabal Palmetto, on flowers of *Seriocarpus* and in a tobacco warehouse.

Distribution.—Known from New Hampshire south to Florida, and west to Texas and Arkansas.

Specimens examined.—217: 22 ♂, 25 ♀, 170 sex undetermined.

NEW HAMPSHIRE: *no further data,* (J. Angus): 1, [AMNH].

NEW YORK: Wyandanch, Long Island, July 15, 1917, (F. M. Schott): 1, [AMNH].

NEW JERSEY: Woodbury: 1 ♀, [CU]; Cassville, June 6-9, 1939, (J. N Belkin): 1; [Author]. Lakehurst, July 26, 1914, (F. M. Schott): 1; [CU]. Malaga, July 20, 1907: 1 ♂ [USNM]. Atlantic City: 2, [RPM]. Lakehurst, June 4, 1919: 1 ♀, [AMNH]. *No further data:* 1, [AMNH].

PENNSYLVANIA: Water Gap, (Chas. Palm): 2, [AMNH]. Allegheny: 2 ♀; Frankford: 1, [USNM].

MARYLAND: Montgomery Co., June 20, 1911, (L. B. Woodruff): 1, [AMNH]. Odenton, June 16, 1918, (H. Dietrich): 8, 1 ♂, [CU]. La Plata: 1; La Plata, July 12, 1931, (J. C. Bridwell): 1, [USNM].

VIRGINIA: Great Falls, June 29, 1911, (L. B. Woodruff): 1; Nelson Co., August 7, 1910, (W. Robinson): 1, [AMNH]. Falls Church, June 22, 1917: 1 ♂, 1; Grassymead, June 19, 1906, (F. Knab): 1; Falls Church, June 22, 1905, (E. S. G. Titus): 1 ♀, 1; Richmond, June 9, 1933, (E. M. Livingstone): 1 ♂, 1 ♀, 5; [USNM].

WEST VIRGINIA: West Sulphur, July 9 1910, (W. Robinson): 1, [USNM].

NORTH CAROLINA: Nance, June 5, 1906, (S. W. Foster): 2, [CU]. Southern Pines, June 6, 1906: 1, [USNM]. Southern Pines, May 21, 1918: 4, [AMNH]. *No further data:* 2 ♀, [CU]. [Also specimens in the Horn Coll., ANSP].

GEORGIA: Raburn Co., July 1; Clark Co., June 12, 1928: 1; *no further data:* 4, [AMNH]. Tallulah Falls, June 19-25, 1909, (J. C. Bradley): 1 ♂, 1; Billy's Island,

Okefenoke Swamp, June 12, 1912: 1 ♂, 1; Honey Island, Okefenoke Swamp, June 1, 1912: 2 ♂; Spring Creek, May 18-25, 1916, (J. C. Bradley): 3; [CU]. Savannah. 1 ♂, [RPM].

FLORIDA: Orange Co., June 21, 1929, (M. M. Smith, Jr.): 1; (W. A. Hier): 1, [USNM]. Fort Meyers, May 7, 1916, (J. C. Bradley): 1, [CU]. Everglade, April 7, 1912: 2, Lakeland, May 6, 1912: 2; Kissimmee, (Chas. Palm): 4; Key Large: 1, *no further data:* 2 [AMNH]. Detroit, May: 1; Miami, May 26, 1937: 1; *no further data:* 2; [CNHM]. Sannibel Island, May 13, 1916, (J. C. Bradley): 1, Royal Palm Park, April 1-5, 1925: 1; Lake Placid, April 2, 1945, (J. G. Needham): 1; Orlando, (J. N. Knull): 1 ♂, [CU]. Miami Co.: 10; Homestead, April 12, 1919, (C. A. Mosier): 1 ♀, 2; [USNM]. Miami, June 5: 1 ♀, 2; Enterprise: 1 ♂, 1 ♀, 2, [RPM]. Lakeland, May 6, 1912: 1 ♂; Orange Co., June 17, 1929, (M. M. Smith, Jr.): 1 ♀, [USNM]. *No further data:* 1, [USNM]. [Also specimens in the Horn Coll., ANSP].

ALABAMA: Leroy, June 11-12, 1917, (R. C. Shannon): 2, [CU]. Spring Hill, June 1, 1917, (H. P. Löding): 1 ♀; Mt. Vernon, June 17, 1917, (H. P. Löding): 2 ♂; Magazine Point, June 9, 1912, (H. P. Löding): 1 ♀, 1 ♂; Tumbling Gap, June 3-8, 1911, (H. P. Löding): 1 ♀, 1; Mobile, (H. P. Löding); 1 ♂, 3 ♀, 2; Coden, June 9, (H. P. Löding): *no further data:* 1, [Alab.]. *No further data:* 1, [AMNH]; 2, [USNM].

TENNESSEE: Great Smoky Mts., Natl. Park, June 24, 1943, (D. J. & J. N. Knull): 2 ♂, 1 ♀, [OSU]. Chattanooga, June 2, 1919; 1, [CNHM].

ARKANSAS: South West, (Chas. Palm): 1, [AMNH]. Tumacacori Mts., July 22, 1940, (D. J. & J. N. Knull): 1 ♂, 2, [OSU]. *No further data:* [CU].

MISSISSIPPI: Lucedale, May 15, 1929, (H. Dietrich): 1 ♂, 2 ♀; Lakesville, May 23, 1930, (H. Dietrich): 1; Lucedale, May 14-24, 1929: 34, May 28, 1931: 7, May 5, 1930: 4, June 13-22, 1932: 2, (H. Dietrich), [CU]. Gulfport, Aug. 1938: 1 ♂, [B. Malkin]. *No further data:* (Chas. Palm): 4, [AMNH].

MISSOURI: St. Louis, July 13, 1937: 1, [CU].

LOUISIANA: *No further data:* 1, [AMNH].

TEXAS: specimens in Horn Coll., ANSP.

NO DATA: 2 ♂, 1, [CU]. 1, [McClay]. 2 ♀, [Alab.].

OXACIS (OXYCOPIS) SUTURALIS (Horn)

Copidita suturalis Horn, Proc. Calif. Acad. Sc., (2), 6: 401, 1896.

This species is variable in color. Usually it may be identified by the testaceous appearance with a narrow marginal stripe fuscous-piceous and the thorax with lateral spots or stripes. It varies in color, however, to entirely piceous.

Holotype: ♀, Georgia, [ANSP (Horn) type no. 8054].

Head: short, coarsely punctate, not rugose, gula smooth. Antennae with each segment nearly uniform throughout. Eyes medium size, oval, very slightly emarginate near base of antennae, moderately projecting. Both mandibles bifid at the tip. Maxillary palpi with the apical segment cultriform, widest near the base.

Thorax: notum slightly longer than broad, widest at apex, sides sinuate, surface coarsely punctate, punctures shallow, as wide as space between. Sternum rugose. Legs slender, claws simple. Elytra surface rugose, costae obscure.

Abdomen with the apical sternite evenly rounded.

Pubescence: entire insect except gular region moderately densely clothed in long, moderately coarse white pubescence.

Color: testaceous with fuscous markings. Head and legs testaceous; antennae with the basal segment fuscous with a testaceous stripe on each side, the following six segments with a narrow basal testaceous band, remainder testaceous; thorax testaceous with lateral bands fuscous; elytra testaceous with a wide fuscous band on each elytron; abdomen testaceous, sternite with two lateral basal fuscous spots.

Length: 12 mm.

Allotype: ♂, same data as type.

The male agrees with the type in all essential details. No sexual dimorphism observed.

Male genitalia.—(Pl. VII, fig. 25). Median lobe stout; base with short, stout dorsally recurved process; apex more slender, with a short, dorsally deflected blunt apical lobe. Paramere with small, broad, dorsally projecting plates; apical lobes long, slender, nearly one-half entire length of paramere, apex of lobes acute, convergent. Tegminite membranous. Ninth abdominal sternite a plate with lateral margins dorsally projecting, apex deeply V-shaped emarginate, base broadly V-shaped with a long, central basal apodeme, dorsally curved. Tergite two rods, apically convergent, broadly united at center by membrane. Eighth abdominal sternite two blunt lobes, united at base. Tergite a simple plate, center membranous. Setae on apex of eighth and ninth sternite and tergite.

Individual variation.—Length: 6-11 mm. Color varies from dark piceous to the color described above for the type.

Biology.—Adults are found on Papaya and Palmetto leaves.

Distribution.—Known from New Jersey southward to Florida, Alabama and Louisiana.

Specimens examined.—157: 15 ♂, 56 ♀, 86 sex undetermined.

NEW JERSEY: Anglesea: 1 ♀, [ANSP (Horn)]. Sandy Hook, June 30, 1910: 1, [AMNH].

MARYLAND: 2.3 mi. E. Piney Pt., July 12, 1931, (H. S. Barber): 1 ♀, Breton Bay, July 12, 1931, (H. S. Barber): 1, [USNM].

VIRGINIA: Cape Henry, July 3, 1938, (L. D. Anderson); 2 ♀, 1; Waehereaout, June 28, 1934, (D. H. Blake): 1 ♀, [USNM]. Hampton, June 25, 1944: 2 ♀ [Mackenzie].

SOUTH CAROLINA: Bluffton, May 19, 1932, (J. G. Watts): 1, [USNM].

GEORGIA: *no further data:* 1 ♂, 1 ♀ [ANSP (Horn) type & allotype].

FLORIDA: Enterprise, May 15-16: 1 ♂, 4 ♀; Capron, April 24-25: 2, [MCZ (LeC.)]; Enterprise: 1 ♀, 6; Biscayne: 2 ♀, [ANSP (Horn) Paratypes?]. Key Largo: 1 ♂, 3, [CAS]. Capron, April 25, 1 ♀, 3; Jupiter, April 24, 6; Cedar Keys, June 4-8: 1 ♂, 4 ♀, 3; Enterprise, May 16-30: 2 ♀, 2; Baldwin: 1; (Hubbard & Schwarz); Miami Beach, April 9, 1918, (T. E. Snyder): 1 ♂, 1, [USNM]. Marco, April 17, 1912: 1 ♂, 1; Everglade, April 14, 1912: 6, 2 ♀; St. Petersburg, April 28, 1908: 2; Flamingo, April 13, 1923: 1 ♀; Fort Meyers, April 20, 1912: 1, [AMNH]. Key Largo, May 13, 1939, (D. J. & J. N. Knull): 1 ♀, 2; Jacksonville, May 20, (R. L. Blickle): 1; Key Largo: 1 ♂; [OSU]. Palm Beach, May 1: 1; Jupiter, May 1: 3 ♀, [RPM]. *No further data:* 2, [CNHM]. Key West, April: 2; Punta Gorda, July 7: 1 ♀; Biscayne, May 3: 1 ♀, 1, (Hubbard & Schwarz) Merritt Island, June 1939, (W. Mathis): 2; Estero, May 6-12, 1908, (VanDuzee): 1 ♂; Miami Beach, April 30, 1922, (H. B. Bailey):

2 ♀, 1; Homestead, April 2, 1938, (J. C. Bradley): 1 ♀; Cutler, May 7, 1908, (Russell): 1 ♀; St. Petersburg, April 28, 1908, (VanDuzee): 1; Enterprise: 1 ♀; New Smyrna Beach, August 11, 1938: 1 ♀; *no further data:* [USNM]. Ft. Lauderdale, April 5, 1947, (J. W. Green): 4 ♂ 15 ♀, 23; [CU]. Palmetto Key, June 3-10, 1942, (C. M. Breder): 5 ♀, 8, [AMNH].

ALABAMA: Mobile, June 13, 1906, (H. P. Löding): 1 ♂, 1 ♀; [Alab.].

LOUISIANA: *no data:* 1; [AMNH].

OXACIS (OXYCOPIS) MIMETICA (Horn)

Copidita mimetica Horn, Proc. Calif. Acad. Sc., (2), 6: 402, 1896.

This species may be easily recognized by the characteristic color pattern. The thorax is orange, margins pale and center with a short, central piceous spot. The elytra are piceous, with the margins outlined by a narrow testaceous stripe.

Lectotype: ♂, Texas, [ANSP (Horn) type no. 8055].

Head short, surface rugose. Antennae with the apical segment ringed at center. Eyes oval, very slightly emarginate near base of antennae. Mandibles both bifid at tip. Maxillary palpi with the apical segment cultriform, widest near base.

Thorax: notum about one and one-fourth times as long as broad, widest at apex, sides sinuate; surface rugose. Sternum rugose. Legs slender, claws simple. Elytra with costae moderate; surface rugose.

Abdomen with the apical sternite evenly rounded; surface finely rugose.

Pubescence: entire insect except gula clothed in moderately dense rather long white pubescence.

Color: piceous with pale testaceous markings. Head piceous except mentum and base of antennae which is pale testaceous. Antennae and abdomen piceous. Thorax reddish-yellow, paler at base and apex with piceous median stripe. Legs with the knees fusco-piceous, apex of tibia shading to piceous, remainder pale testaceous. Elytra piceous with narrow sutural stripe and broad humera stripe pale testaceous.

Length: 7 mm.

Male genitalia.—(Pl. VIII, fig. 26). Median lobe short, stout, base with a short broad, dorsally recurved process; apex with a dorsally deflected short lobe or knob. Paramere with narrow lateral-basal plates which are only slightly dorsally curved; apex with two long, moderately thin lobes, which are about one-half entire length of paramere. Tegminite a moderately short lobe, with apex slightly expanded and slightly emarginate at apical end, weakly chitinized. Ninth abdominal sternite a plate with apex deeply, broadly emarginate, sides parallel, base broadly V-shaped with a basal median process. Tergite two rods nearly parallel, expanded apically, and united by membrane. Eighth abdominal sternite two lobes united at base, apex moderately acute, slightly convergent. Tergite a simple plate, apex arcuate, center membranous. Setae present on apex of tegminite, ninth and eighth sternite and tergite.

Female.—Tallulah, Louisiana, June 1933, [CU].

The female agrees with the male in all essential characters.

Length: 8 mm.

Individual variation.—Very slight variation observed.

Length: 6-9 mm.

Biology.—Adults are collected at light.

Distribution.—This species is known from New Jersey south to Florida and west to Iowa, Kansas, Arkansas and Texas.

Specimens examined.—34: 4 ♂, 13 ♀, 17 sex undetermined.

NEW JERSEY: Hopatcong: 1, [AMNH].

MARYLAND: Plummer's Island, June 25, 1932, (H. S. Barber): 1 ♀, [USNM].

IOWA: *no further data:*, [RPM].

KANSAS: Mt. Hope, June 20: 1 ♀, [USNM]. Reno Co., (J. C. Warren): 3, [AMNH]. W. Kans.: 1 ♀, [ANSP]. *No further data:* 1, [MCZ LeC.)].

ARKANSAS: Pine Bluff, May 26, 1933, (M. A. Cazier): 2, [AMNH].

FLORIDA: Sanibel, April 26, 1927, (M. D. Leonard): 1 ♂, [CU].

ALABAMA: Mobile, May 25, 1930, (H. Dietrich): 1 ♂, 2 ♀; Mountsano, Madison Co., May 19, 1932, (H. P. Löding), 1, [CU]. Mobile, June 1920, (H. P. Löding): 1 ♀; Tuscaloosa, June 20, 1935, (H. P. Löding): 1; Mobile Co., June 29, 1930, (H. P. Löding): 1 ♀, [Alab.].

MISSISSIPPI: Lucedale, May 29, 1930, (H. Dietrich): 1 ♀, [CU]. Gulfport, Aug. 1938: 1 ♀; [Malkin]. Durant, June 21, 1915, (G. G. Ainslie): 1, [USNM].

LOUISIANA: Tallulah, June 1933, 1 ♂, 1 ♀, [CU].

TEXAS: Houston, June 15, 1932: 1 ♂; *no further data:* 1 ♀, [ANSP]; Gillespie Co., May 2, 1935, (J. N. Knull): 1; [OSU]. Lee Co., June 23, 1899: 1; *no further data:* 1 ♀, [AMNH].

NO DATA: 1, [ANSP]. 1, [CNHM].

OXACIS (OXYCOPIS) FULIGINOSA LeConte

Oxacis fuliginosa LeConte, New Species Co., 1: 166, 1866.—Horn, Proc. Calif. Acad. Sc., (2), 6: 403, 1896, (*Copidita*).

This obscure species may be readily distinguished by the uniform dark fuscous color and the prominent elytral costae. It is much darker than *O. mariea*, which lacks elytral costae.

Holotype: ♂, Lower California, [MCZ (LeC.), type no. 4801].

Head: short, finely punctate, punctures set slightly closer than their width. Antennae with the apical segment slightly constricted at center, each segment somewhat broader apically, each segment two and one-half times its width at center. Eyes large, nearly circular, scarcely emarginate, protruding. Mandibles both bifid at apex. Maxillary palpi with the apical segment moderately broad, widest near apex.

Thorax: notum no longer than broad, broadest apically, sides sinuate, surface moderately punctate, punctures set closer than their width; weakly rugose at base of coxae. Sternum rugose. Legs slender, claws simple. Elytra rugose.

Abdomen with the apical segment evenly arcuate, rugose, costate.

Pubescence: entire insect except gular region and notum at base of coxae

covered with moderately long, moderately dense, coarse white pile, most apparent on costae of elytra, which appear white striped.

Color: head, antennae, thorax except for venter which is piceous, legs, elytra and abdomen dark fuscous.

Length: 7 mm.

Male genitalia.—(Pl. VIII, fig. 27). Median lobe short, stout, base with a short, broad, dorsally recurved process, apex stout, blunt, slightly dorsally deflected. Paramere: basal plate stout, dorsally projecting, base deeply emarginate; apical lobes long, about one-half the entire length of the paramere, apex acute, lobes straight. Tegminite a broad plate, apex slightly expanded, arcuate. Ninth abdominal sternite a plate with lateral margins parallel, apex deeply emarginate, base broadly V-shaped with a long median process. Ninth tergite consisting of two slightly chitinized parallel rods broadly separated and united by membrane, apex arcuate. Eighth abdominal sternite two stout lobes united at base. Eighth tergite a plate laterally chitinized, center membranous, apex arcuate. Setae present on apex of ninth and eighth sternite and tergite.

Female.—20 mi. N. Comondu, Lower California, July 23, 1938, (Michelbacher & Ross). [CAS].

The female agrees with the male in all essential details, exhibiting no sexual dimorphism.

Individual variation.—Only observed variation in specimens studied was the length: 5-9 mm.

Biology.—Unknown.

Distribution.—Known only from Lower California.

Specimens examined.—19: 10 ♂, 9 ♀.

LOWER CALIFORNIA: 20 mi. N. Comondu, July 23, 1938: 1 ♀; Santiago, July 8, 1938: 1 ♂, 2 ♀; 6 mi. N. Triunfo, July 15, 1938: 2 ♂, 2 ♀; 10 mi. S. W. San José del Cabo, July 9, 1938: 2 ♂; Triunfo, July 7, 1938: 2 ♀; Coyote Cove, Conception Bay, July 24, 1938: 1 ♂; 45 mi. N. San Ignacio, July 27, 1938: 1 ♂, 1 ♀; 25 mi. S. Santa Rosalia, July 25, 1938: 1 ♂, 1 ♀, (Michelbacher & Ross), [CAS]. *No further data:* 2 ♂, [MCZ (LeC.)].

Oxacis (Oxycopis) luteostriata new species

This new form may be distinguished by the prominent elytral costae with denser, coarser white pubescence on the costae. The pronotum is orange to piceous, the elytra with a slight metallic blue-green reflection to fuscous or piceous. Moderately large.

Holotype: ♀, Palmetto Key, Florida, June 19-26, 1942, (C. N. Breder), [AMNH].

Head: moderately short, punctate, punctures small, set closer together than their width; gula bare. Antennae with each segment scarcely enlarged apically, each segment long, about six times as long as wide, apical segment not constricted at center. Eyes large, oval, slightly emarginate. Mandibles both bifid at apex. Maxillary palpi with the apical segment large, cultriform, widest near base.

Thorax: notum longer than broad, broadest near apex, sides sinuate, surface punctate, punctures small, set closer together than their width; bare at base of coxae. Sternum weakly rugose. Legs slender, claws simple. Elytra rugose, costate.

Abdomen weakly rugose, apical segment arcuate, slightly produced.

Pubescence: entire insect except sides of pronotum near base of coxae and gula covered with moderately dense, moderately long white pubescence, that on the costae most dense giving the appearance of white stripes.

Color: dull metallic greenish-blue, with fuscous markings. Head dull metallic greenish-blue except the mouth parts which are dark testaceous. Antennae and thorax dark testaceous. Femora metallic greenish-blue, tibia and tarsi dark testaceous. Elytra metallic greenish-blue, margins and suture with narrow testaceous band, white pubescence appearing as white stripes on costae. Abdomen metallic greenish-blue.

Length: 11 mm.

Male.—Unknown.

Individual variation.—No essential variation observed.

Length: 9-11 mm.

Biology.—"Swarms on the flowers of black mangrove and buttonwood in the spring."—Strohecker, in litt.

Distribution.—Known only from Miami, Florida, south to Palmetto Key.

Paratypes.—Other than the type specimen, the following nine paratypes are known.

FLORIDA: Miami, June 10, 1941, (Everett): 1 ♀; May 20, 1937: 1 ♀; Coral Gables, July 1, 1939, (Cararasios): 1 ♀, [Miami]. Palmetto Key, June 19-26, 1942, (C. M. Breder): 3 ♀; Marco, April 17, 1912: 2 ♀; [AMNH]. Miami, May 26, 1933: 1 ♀, [McClay].

Oxacis (Oxycopis) mcdonaldi* new species

This is undoubtedly one of the most distinctive and easily recognized species of this genus. The delicate coloring of the thorax and elytra is remarkably constant for this species. It may be readily identified by the orange-red color of the thorax, with a median indefinite piceous longitudinal thoracic stripe. The elytra are a delicate uniform metallic blue-green, without costae. It is a moderately small species.

Holotype.—♂ Cutler, Florida, May 6, 1918, (Russell), [USNM Cat. no. 58978].

Head: moderately short, surface punctate; punctures moderately small, irregular, surface between punctures rugose. Antennae with each segment six times as long as broad, apical segment narrowing abruptly at center; inserted close to eyes and base of mandibles. Eyes oval, very slightly emarginate near antennae. Mandibles small, apices of both bifid. Maxillary palpi with the apical segment large, cultriform, widest at base.

* This species is dedicated to the memory of my friend, Edward D. McDonald, Jr., a promising young entomologist who lost his life in the attempt to save another's.

Thorax: notum slightly broader than long; surface finely punctate, punctures irregular, surface between finely rugose. Sternum finely rugose. Legs slender, claws simple, base quadrate. Elytra rugose, vaguely costate.

Abdomen rugose, apical segment slightly emarginate.

Pubescence: entirely covered with fine, moderately dense, short golden recumbent hairs.

Color: head piceous; antennae fuscus; thorax orange with median narrow indefinite stripe; legs piceous-fuscous; elytra metallic blue-green; abdomen piceous.

Length: 7 mm.

Male genitalia.—(Pl. VIII, fig. 30). Median lobe short, apex blunt, but more slender than the shaft, slightly dorsally deflected; base with a short, dorsally projecting median stout process, with very small, internal sub-basal apodeme. Paramere small, broad, apical lobes short, less than one-third the entire length, apex acute, apically convergent; base wtih large, expanded plates, dorsally projecting, base emarginate deeply, nearly to apical lobes. Tegminite small, slender, poorly chitinized. Ninth abdominal sternite a plate with basal lateral margins basally convergent into a median process; apex of plate expanded, bluntly arcuate, deeply emarginate. Tergite two weak rods broadly united by membrane. Eighth abdominal sternite two blunt lobes, apex slightly convergent, base broad, united. Tergite a plate with lateral margins chitinized, center membranous, apex arcuate. Setae present on the apex of the eighth and ninth sternite.

Allotype: ♀, same data as Holotype. Agrees with the holotype in all essential respects except that the apex of the last abdominal sternite is evenly arcuate.

Length: 8 mm.

Paratypes: The following 64 specimens have been studied and are designated as paratypes and are deposited in the collection indicated.

FLORIDA: Miami, May 26, 1937: 1 ♀; *no further data:* April 29, 1938: 1 ♀, [Miami]. Miami, May 26, 1937: 1 ♂, [McClay]. Dade Co., May 12, 1939, (D. J. & J. N. Knull): 1 ♂, 3 ♀, [OSU]. Homestead, April 18, 1923: 1 ♂; Marco: 1 ♀; Kissimmee, (Chas. Palm): 1; Everglade, April 10, 1912: 6 ♂, 19 ♀, [AMNH]. Merritt Island, June 1939, (W. Mathis): 1; Key West, (F. Knab): 2 ♀; Culter, May 6, 1908, (Russell): 3 ♂, 2 ♀, [USNM]; Sanibel, April 26, 1927, (M. D. Leonard): 10 ♂, 11 ♀, [CU].

Individual variation.—Length: 5-9 mm. Thorax with median stripe sometimes reduced, rarely absent. Coloration of elytra usually metallic blue-green, rarely with a purple tinge and rarely with a narrow pale median stripe. Maxillary palpi with apical segment widest rarely near center, but always basally from center. Apical segment of both sexes sometimes shallowly emarginate, or evenly arcuate.

Biology.—Adults have been collected on papaya leaves.

Distribution.—Known only from Florida.

Oxacis (Oxycopis) dietrichi new species

This species may be readily distinguished from the others of this subgenus by the presence of a fuscous median stripe on the otherwise pale elytron.

Holotype: ♂ Ocean Springs, Mississippi, April 24, 1932, (H. Dietrich) [CU (type no. 2415)].

Head: short, rugose; gula somewhat transversely rugose. Antennae with each segment slightly expanded apically; apical segment constricted at center. Eyes small, set forward, elongate oval, slightly emarginate. Mandibles short, both bifid at apex. Maxillary palpi with the apical segment large, cultriform, widest at base.

Thorax: notum as broad as long, slightly wider near the apex, sides slightly sinuate; rugose, smooth at base of coxae. Sternum rugose. Legs slender, claws simple.

Abdomen rugose, apical segment very slightly emarginate.

Pubescence: entire insect except gular region moderately densely clothed in long white pubescence.

Color: testaceous with fuscous markings. Head and legs entirely testaceous. Antennae with the first seven segments basally testaceous, apically fuscous, remainder fuscous. Thorax testaceous with two broad lateral fuscous stripes, venter piceous. Elytra testaceous with a narrow fuscous median stripe on each elytra. Abdomen with each sternite piceous with a narrow apical testaceous band.

Length: 10 mm.

Male genitalia.—(Pl. VIII, fig. 29). Median lobe short, apex with a narrow terminal lobe which is three times as long as broad, slightly dorsally deflected; base with a broad, dorsally curved basal process. Paramere with base stout, broad, basal plates broad, dorsally projecting; apical lobes short, about one-third the entire length of the paramere, thin, acute at apex and convergent. Tegminite obscure, membranous. Ninth abdominal sternite a plate with basal lateral margins basally convergent into a median process; apex of plate expanded, bluntly arcuate, deeply emarginate. Tergite two weak rods broadly united by membrane; base broad, united. Tergite a plate with lateral margins chitinized, center membranous, apex arcuate. Setae present on the apex of the eighth and ninth sternite.

Allotype: ♀, same data as male.

The female agrees with the male except that the apical sternite of the abdomen is evenly arcuate.

Paratypes: In addition to the type and allotype, the following two paratypes are designated; same data as type: 2♂, [CU].

Individual variation.—None observed in this short series.

Biology.—Unknown.

Oxacis (Oxycopis) mariae new species

This species is closely allied to *O. fuliginosa* LeC. which also has the apical segment of the maxillary palpi widest near the apex. This species

may be separated from *O. fuliginosa* LeC. by the absence of elytra costae and by the short golden vestiture instead of the white, moderately coarse hairs of *O. fuliginosa* LeC.

Holotype: ♂, 15 mi. S. E. Arrohoseco, Lower California, July 16, 1938, (Michelbacher & Ross), [CAS].

Head: short, finely, sparsely punctate. Antennae with the apical segment barely constricted at center; each segment three and one-half times as long as broad. Eyes large, nearly circular, scarcely emarginate, somewhat protruding. Mandibles thin, both bifid at apex. Maxillary palpi with the apical segment slender, widest near the apex.

Thorax: notum longer than broad, widest towards the apex; sides sinuate; surface finely and closely punctate. Sternum rugose. Legs slender, claws simple. Elytra rugose, without trace of costae.

Abdomen: the apical sternite evenly arcuate, surface rugose.

Pubescence: entire insect except gula covered with fine, very short, golden pubescence.

Color: fusco-testaceous, darker between the eyes; elytra dark with indefinite sututal area paler.

Length: 5 mm.

Male genitalia.—(Pl. VIII, fig. 28). Median lobes short, stout, apex blunt, slightly dorsally curved; base with a short, broad dorsally projecting process. Paramere: broad, plates small, base deeply emarginate, more than one-third the entire length; apex with stout, straight lobes, apex blunt, lobes more than one-third the entire length. Tegminite small, weakly chitinized, a simple lobe, apex blunt. Ninth abdominal sternite a plate with basal lateral margins basally convergent into a median process; apex of plates expanded, bluntly arcuate, deeply emarginate. Ninth tergite two weak rods, broadly united by membrane. Eighth abdominal sternite two blunt lobes, apex slightly convergent, base broad, united. Eighth tergite a plate with lateral margins chitinized, center membranous, apex arcuate. Setae present on the apex of the tegminite, and eighth and ninth sternite.

Allotype: ♀, 45 mi. N. San Ignacio, Lower California, July 16, 1938, (Michelbacher & Ross), [CAS].

The female agrees with the male in all essential respects.

Length: 8 mm.

Paratypes: The following three paratypes are designated and deposited as indicated.

LOWER CALIFORNIA: 15 mi. W. Las Paz, July 5, 1938: 1 ♂; Santiago, July 8, 1938: 1 ♀, (Michelbacher & Ross), [CAS].

ARIZONA: Agnila, July 1, 1941, (W. F. Barr): 1 ♀, [Idaho].

Individual variation.—No essential variation observed in this short series.

Length: 5-8 mm.

Biology.—Unknown.

Subgenus XANTHOCHROINA Ganglbaur

Xanthochroina Ganglbaur, Verh. zool.-bot. Ges. Wien 31: 98, 105, 1881.

Genotype: Xanthochroina auberti (Abeille), Bull. Soc. Ent. France, 1876: clxvi, (*Xanthochroa*). [Monobasic.]

This subgenus contains two species, the genotype from France, and the Nearctic species, *Oxacis bicolor* (LeC.). The short head, small eyes and the median lobe of the male genitalia with a sub-basal apodeme are prominent characters which separate this subgenus from the other three subgenera recognized in this genus.

Subgeneric diagnosis.—Head short, eyes small, oval, slightly emarginate, distance behind the eyes twice the distance in front to the base of the mandibles. Mandibles small, curved, acute. Notum of the thorax broader than long, broadest apically. Legs slender, apical tibial spurs 2-2-2, claws all simple.

Male genitalia.—Median lobe long, curved, base with a long dorsally recurved process and a sub-basal apodeme. Paramere with basal-lateral plates and apical lobes. Tegminite moderately long, apex expanded. Ninth abdominal sternite a simple plate with a long basal process. Tergite a simple, narrow plate. Eighth abdominal sternite two lobes, united at the base. Tergite a simple plate, center membranous.

Distribution.—The one Nearctic species known is confined to the western states.

OXACIS (XANTHOCHROINA) BICOLOR (LeConte)

Asclera bicolor LeConte, Ann. Lyc. Nat. Hist., N. Y., 5: 158, 1851.—LeConte, New Species Col., 1: 166, 1866.—Horn, Proc. Calif. Acad. Sc., (2), 6: 417, 1896.

This species, the only one of the subgenus, is distinguished by the small eves, the testaceous thorax and dark elytra, the short head and the small, sharp mandibles.

Holotype: ♂ Oregon, [MCZ (LeC.), type no. 4800, (blue disc)].

Head: very short, punctate, punctures sparse, small, indistinct, area between punctures smooth. Antennae with the apical segment constricted at the center, narrower beyond the constriction; each segment two and one-half times as long as broad, somewhat wider apically. Eyes small, elongate oval, slightly emarginate. Mandibles small, thin, acute at apex. Maxillary palpi small, apical segment widest beyond the center.

Thorax: notum broader than long, widest apically, sides sinuate; surface punctate, punctures and surface similar to that of the head. Sternum punctate, slightly more so than the notum. Legs slender, claws simple. Elytra finely rugose.

Abdomen: finely punctate, apical sternite evenly arcuate.

Pubescence: sparsely covered with fine, short golden hairs.

Color: piceous with yellow markings. Head, antennae, thorax, and legs yellow; elytra piceous; abdomen piceous shading to yellow towards apex.

Length: 8 mm.

Male genitalia.—(Pl. VIII, fig. 31). Median lobe long, slender, curved; apex with a slight apical knob; base with a single, dorsally recurved process and a sub-basal apodeme. Paramere: base with thin dorsally projecting plate; apex with two lobes; lobes nearly one-half the entire length. Tegminite: a simple lobe with the apex slightly expanded. Ninth abdominal sternite a plate, the apex deeply emarginate, V-shaped; base truncate with a long dorsally curved rod. Ninth tergite a simple, thin plate, apex slightly expanded, arcuate. Eighth abdominal sternite two lobes united at base. Eighth tergite a plate membranous at the center, apex arcuate. Setae present on the apex of the tegminite, ninth and eighth abdominal sternite and tergite.

Allotype: ♀, Arizona, [MCZ (LeC.)].

The female agrees with the male except that the apex of the apical abdominal sternite is somewhat more produced than the male.

Individual variation.—This species is particular constant in coloration, an exception to the rule for this genus. The punctation and vestiture is constant. The size of the eyes shows some variation in size in the specimens studied, however, they are always small in comparison with the other members.

Length: 6-9 mm.

Biology.—The larvae of this species are wood boring. There are numerous specimens in the United States National Museum collection which were taken from a floor laid on basement concrete of a schoolhouse at Carper, Wyoming. They were also taken from the woodwork of a schoolhouse, and in railroad ties. Several adults were taken from the lower levels of the Argonaut Mine in California where they are reported to have bitten a man and caused severe inflammation. It is probable that the larvae were working in the mine timbers. The cause of the inflammation has not been substantiated, however, and it is probable that the cause was not from bites, but rather from the claws on perspiration-covered skin, which could easily cause an inflammation, itching and swelling, especially on a person of light complexion. [This biological information is recorded on labels attached to the insect pin of each specimen by Mr. H. S. Barber of the United States National Museum.]

Distribution.—This species is known from the Rocky Mountain states and from British Columbia, Canada.

Specimens examined.—148: 46 ♂, 84 ♀, 18 sex undetermined.

BRITISH COLUMBIA: Kaslo, (A. N. Caudell): 1 ♂, 4 ♀, [USNM]. [Specimens also in the ANSP coll.].

WASHINGTON: W[ashington] T[erritory], *no further data:* 1 ♂, [MCZ (LeC.)]. [Specimens also in the ANSP coll.] Dry Creek, alt. 3,000 ft., June 28, 1936, (R. W. Every): 1 ♂ [Idaho]. Wenatchee, July 20, 1928, (M. D. Leonard): 1 ♂, 2 ♀; Yakima, July 8, 1929: 1 ♀; July 28, 1928, (M. D. Leonard): 4 ♀, [CU]. Ritzville, August 13, 1920, (R. C. Shannon): 3 ♂, 1 ♀; [USNM]. *No further data:* 1 ♀, [CNHM].

OREGON: Eugene, July 1946, (B. Malkin): 1 ♀, [Malkin]; Dayton, June 20, 1940: 1 ♀, [Fender]. Pacific City, July 21, 1942, (K. M. Fender): 1 ♀, [Mackenzie]. McMinnville, Aug. 4, 1940, (K. M. & D. M. Fender): 8 ♀, [Fender]. *No further data:* 1 ♂, [MCZ (LeC.)].

IDAHO: Moscow, alt. 2,500 ft., July 24, 1936, (B. F. Coon): 1 ♀; *same,* alt. 4,000 ft., July 4, 1936: 2 ♂; *same,* Aug. 25, 1930, (Paul Rice): 1 ♀; Parma, (C. Wakeland): 1 ♂; Kellogg, (W. E. Shull): 2 ♂, 2 ♀, [Idaho]. Coeur d'Alene, May 9, 1946, (L. D. Tuthill): 3 ♂, 1 ♀; Wallace, Aug. 30, 1931, (E. C. Zimmerman): 3 ♀, [USNM]. *No further data:* 1 ♀, [MCZ (LeC.)].

CALIFORNIA: Siskiyou Co., July 10, [USNM]. Lake Arrowhead, July 11, 1942, (G. P. Mackenzie): 2 ♀, [Mackenzie]. Sequoia Natl. Park, alt. 2,000-3,000 ft., July 16, 1936, (A. T. McClay): 1 ♀, Clarksbury, July 2, 1931, (A. T. McClay): 1 ♂: [McClay]. San Diego, July 26, 1919, (Dr. F. Psota): 1 ♂, 1 ♀; [CNHM]. Argonaut Mine, Mar. 2, 1916, (Van H. Manning): 1 ♂, 4 ♀, [USNM]. Pasadena: 1 ♀, [CU]. Santa Rosa Mts., June 25, 1946, (D. J. & J. N. Knull): 1 ♂, [OSU]. Berkeley, Sept. 17, 1919, (H. Dietrich): 1 ♂; Pasadena, (Dr. A. Fenyes): 3 ♀; [CU]. *No further data:* (Chas. Palm): 1 ♀, [AMNH]. [Also specimens in ANSP].

NEVADA: Las Vegas, June 30, 1937, (D. J. & J. N. Knull): 1 ♂, 2 ♀, [OSU]. [Also in ANSP coll.].

UTAH: Oak Creek Canyon, July 21, 1936, (L. Jeppson): 1; [CNHM]. Washington Co.: 1 ♂, [USNM]. *No further data:* 1; [AMNH].

WYOMING: Casper, Sept. 8, 1937, (Margert Greenwood): 10 ♀, Casper: 3, [USNM].

COLORADO: Suber, Aug. 1904: 1 ♂, [AMNH]. Salida, (Dyar & Caudell): 1 ♀, [USNM].

ARIZONA: White Mts.: 2 ♂, 4 ♀, [CU]. Patagonia, July 5, 1936, (M. Cazier): 2, [AMNH]. Payson, Aug.: 3 ♀; Base of Pinal Mts., April 11, (D. K. Duncan): 1 ♂; [RPM]; Chiricahua Mts., June 15, 1940, (D. J. & K. N. Knull): 1 ♂, 2 ♀; [OSU]. Huachuca Mts., July 20, 1937: 1 ♂; Tucson, June 8, 1937: 1 ♀; Prescott N. F., July 6, 1937: 1 ♀; Flagstaff, July 30: 1 ♂; (D. J. & J. N. Knull), [OSU]. Senator, (Chas. Palm): 1 ♀; Tucson, (Chas. Palm): 2 ♀; Patagonia, July 5, 1936, (M. Cazier): 2 ♂, [AMNH]. Williams: 1, [USNM]. *No further data:* 1 ♀, [CU]. 1 ♀, [MCZ (LeC.)]. [Also in ANSP coll].

NEW MEXICO: Lamy, (R. & H.): 1 ♀, [ANSP]. Near Hot Springs, Las Vegas Co., July 1882, alt. 7,000 ft., (F. H. Snow): 1 ♀, [MCZ (LeC.)]. Jemez Springs, (J. Woodgate): 1 ♂, [CU]. Albuquerque: 2 ♂, [USNM]. Albuquerque, (M. L. Linell): 1 ♀, [USNM]. Las Vegas, May 8, (Barber & Schwarz): 3 ♂, [USNM]. Jemez Springs, 1923; 2 ♀ [CU].

TEXAS: Davis Mts., July 2, 1940, (D. J. & K. N. Knull): 1 ♂, 2 ♀, [OSU].

Paroxacis new subgenus

Genotype: Probosca lucana LeConte. [Present designation.]

This subgenus is erected for the following four species of *Oxacis* all of which have the tarsal claws toothed. The median lobe of the male genitalia has a sub-basal apodeme.

Subgeneric diagnosis.—The head short, eyes ovoid, slightly emarginate, large. Mandible varying with the species, apex always simple. Antennae eleven-segmented, each segment elongate, normal in size. Thorax with notum longer than broad; legs slender; apical tibial spurs 2-2-2, claws toothed, tooth usually prominent. Elytra without costae. Abdomen normal, apical sternite evenly arcuate at apex, showing little or no sexual dimorphism.

Male genitalia.—Median lobe moderately short, stout, base with dorsally recurved process and with sub-basal apodeme. Paramere with prominent basal, dorsally projecting plates and with the apex bi-lobed, lobes variously modified. Tegminite a lobe varying with the species. Ninth abdominal

sternite a plate variously modified with a long basal apodeme. Tergite variously shaped. Eighth abdominal sternite two lobes united at the base. Tergite a simple plate which is membranous at the center.

Distribution.—The species of this subgenus are found in the extreme southern parts of the United States and in Mexico.

KEY TO THE SPECIES

1. Mandibles large, blunt at the apex, curved in and downward; elytra with indistinct apical marginal stripe ..... *lucana* LeC.
   Mandibles small, acute at apex, curved in and straight; elytra not so colored 2
2. Entirely testaceous ..... *debilis* Horn
   Testaceous marked with fuscous 3
3. Elytra testaceous with a distinctly limited humeral stripe extending to apex ..... *interrita* n. sp.
   Elytra fuscous or dark with indistinctly limited sutural and narrow humeral stripes testaceous ..... *recendita* n. sp.

KEY TO THE MALES

1. Each lobe of paramere with a small dorsal prominence about midway to apex; lobes adorned with stout spines externally ..... *debilis* Horn
   Paramere otherwise modified 2
2. Each lobe of paramere with a small dorsal, basal prominence; lobes without setae ..... *recendita* n. sp.
   Lobes of paramere without prominences, but fine setae present externally 3
3. Apex of median lobe with expanded knob ..... *lucana* LeC.
   Apex of median lobe acute ..... *interrita* n. sp.

OXACIS (PAROXACIS) LUCANA (LeConte)

Probosca lucana LeConte, New Species Col., 1: 167, 1866.—Champ., Biol. Centr.-Amer., Col., (4), 2: 152, 1890, (*Oxacis*).—Horn, Proc. Calif. Acad. Sc., (2), 6: 419, 1896, (*Oxacis*).

This species may be distinguished from the following species by the very stout, in and down curved, long mandibles, the vague fuscous stripe along the external lateral margin of the elytra and by shape of the tegminite of the male genitalia. Closely related to *O. debilis* Horn.

Holotype: ♂ Lower California, Cape San Lucas, (Mr. Xanthus), [MCZ (LeC.) type no. 4803].

Head: Moderately short, punctate-rugose, gula smooth. Antennae with the apical segment devoid of a median ring; each segment slender, very slightly wider apically; each segment six times as long as broad. Eyes ovoid, nearly circular, very slightly emarginate. Mandibles moderately stout, slightly deflected downward, apex moderately acute. [This specimen is not typical of the species unfortunately; see individual variations]. Maxillary palpi with the apical segment widest near the base.

Thorax: notum slightly longer than broad, widest apically, sides slightly sinuate, surface rugose punctate. Sternum rugose. Legs slender, claws acutely toothed at base. Elytra finely rugose, vaguely costate.

Abdomen finely rugose, apical sternite evenly arcuate.

Pubescence: entirely covered with moderately sparse, moderately short, moderately fine yellowish white recumbent hairs.

Color: pale testaceous, elytra with apically indistinct moderately broad, fuscous stripe; abdomen testaceous with apex darker.

Length: 12 mm.

Male genitalia.—(Pl. IX, fig. 32). Median lobe long, moderately slender, apex with slight knob; base with long, dorsally recurved process and sub-basal apodeme which is slender. Paramere: basal, dorsally projecting plates slender, elongate; apical lobes one-half the entire length of the paramere, apically curved, convergent. Tegminite a simple lobe, apically enlarged and evenly arcuate. Ninth abdominal sternite a plate apically deeply V-shaped emarginate, basally broadly V-shaped with long basal process. Tergite broad at base, sides sinuate, narrower than base, apex slightly expanded but much narrower than base, arcuate; center membranous. Eighth abdominal sternite two slender lobes, apically convergent, acute; united basally. Tergite a simple plate, membranous at center, apex arcuate and moderately emarginate. Setae on lobes of paramere, apex of: tegminite, eighth and ninth abdominal sternite and tergite.

Allotype: ♀, same data as Holotype.

The female agrees with the male in all respects except that the mandibles are stouter and blunter at the apex, and the body is more distinctly punctate.

Length: 11 mm.

Individual variation.—The type specimen unfortunately is not typical of the species. The type series for the most part is darker and the mandibles are not as stout as the other specimens studied. Horn mentions in his monograph that the species is markedly variable. In general, the color is pale testaceous; the mandibles are stout, blunt at the apex, large, and apically convergent and strongly deflected at the apex. The punctation is fairly distinct, of moderate size. There is little doubt about the placing of these specimens, however, and the male genitalia readily separate this species from its close relative, *O. debilis* Horn.

Biology.—Unknown.

Distribution.—This species is known from Lower California, Sonora, Mexico, and Arizona.

Specimens examined.—35: 7 ♂, 9 ♀, 19 sex undetermined.

LOWER CALIFORNIA: Cape San Lucas: 1 ♀; *no further data,* (Cape San Lucas according to LeConte's description): 1 ♂, [type]; 3 ♂, 2 ♀, 1; [MCZ (LeC.)].

MEXICO: Hemosillo, Sonora, Sept. 1, 1903: 1, [CU].

ARIZONA: Camp Verde, Aug. 9, 1933, (K. Maehler): 1; *no further data:* (Chas. Palm): 1 ♂, 2 ♀, 1, [AMNH]. Phoenix, Aug. -, 1917: 1; [CU]. Hot Springs, July 24, (Barber & Schwarz): 1; Tempe, (V. L. Wiedermuth): 1 ♂, 9; [USNM]. (Specimens labeled *Ariz.* also in Horn Coll. [ANSP]).

NO DATA: 1 ♂, 4 ♀, 4, [MCZ (LeC.)].

OXACIS (PAROXACIS) DEBILIS Horn

Oxacis debilis Horn, Proc. Calif. Ac. Sc., (2), 6: 420, 1896.

This species may be readily distinguished by the toothed claws, the thin mandibles, the entirely testaceous color and the median prominence on the lobes of the paramere of the male genitalia.

Holotype: ♀, California, [ANSP (Horn) lectotype no. 8066].

Head: short, surface rugose-punctate. Antennae with each segment about five times as long as wide, not expanded apically, apical segment without medain ring. Eyes slightly ovoid, slightly emarginate. Mandibles moderate, acute and thin at apex. Maxillary palpi with the apical segment widest near the base.

Thorax: notum slightly longer than broad, broadest apically, sides sinuate; surface moderately rugose-punctate. Sternum finely rugose. Legs slender, claws poorly toothed, tooth very small, but distinct, about half way to apex, appearing to be merely quadrately enlarged at base with a tiny spur. Elytra finely rugose, not costate.

Abdomen: apical sternite evenly rounded.

Pubescence: entirely covered with very fine, short, recumbent dense golden pubescence.

Color: entirely testaceous.

Length: 7 mm.

Allotype: ♂, Escondido Bay, Lower California, June 14, 1921, (E. P. VanDuzee), [CAS].

The male agrees with the female in all essential respects.

Length: 6 mm.

Male genitalia.—(Pl. IX, fig. 33). The median lobe is short, stout; apex curved, acute; base with dorsally recurved process; short sub-basal apodeme. Paramere: basal, dorsally projecting plates moderate; apex with two lobes, nearly one-half the entire length of the paramere; a slight dorsal protuberance midway to apex of each lobe. Tegminite a short lobe, expanded apically. Ninth abdominal sternite a plate slightly and broadly emarginate apically, basally truncate with a long basal process. Tergite a broad plate, membranous at center, apex arcuate. Eighth abdominal sternite two lobes, apex acute, base united. Tergite a simple plate, apically arcuate and slightly emarginate, center membranous. Setae present on external-lateral surface of each lobe of the paramere, apex of tergminite, and apex of the eighth and ninth abdominal sternite and tergite.

Individual variation.—The tooth of the claw varies slightly with the specimens examined, being more prominent in some specimens than those of the type. The coloration of a few specimens was generally darker than the type, one with a vague median pronotal stripe and with a darker cloudy median-basal area on the elytra.

Length: 7-12 mm.

Biology.—Unknown.

Distribution.—Known only from a few specimens, mainly from California and Lower California with one specimen from Arizona.

Specimens examined.—19: 5 ♂, 7 ♀, 7 sex undetermined.

LOWER CALIFORNIA: Escondido Bay, June 14, 1921, (E. P. VanDuzee): 2 ♂ 2; Coyote Cove, Conception Bay, June 29, 1938: 1 ♂, 2 ♀, 2; 10 mi. E. Mesquital, June 23,

1938: 1 ♀; 15 mi. N. Punta Prieta, July 29, 1938: 1 ♀, (Michelbacher & Ross): [CAS].

CALIFORNIA: Pond Island Bay Gulf, June 20, 1921: 1 ♂, 1 ♀; Angeles Bay Gulf, June 26, 1921: 1 ♂, 1; San Carlos Bay Gulf, July 8, 1921: 1; (E. P. VanDuzee), Conception Bay Gulf, June 18, 1921, (J. C. Chamberlian): 1 ♀, [CAS]. *No further data:* 1 ♀; [ANSP (Horn) type].

ARIZONA: *no further data:* 1, [ANSP].

Oxacis (Paroxacis) recendita new species

This species may be identified by the nearly entirely fuscous elytra with a narrow pale sutral strip only.

Holotype: ♂, Brownsville, Texas, (Boca Chica), July 13, 1947, (B. D. Valentine), [USNM Cat. no. 58776].

Head: moderately long, surface rugose. Antennae with the apical segment without median ring; each segment five times as long as broad. Eyes large, nearly circular, very slightly emarginate at point of insertion of antennae. Mandibles long, slender, straight, apex acute. Maxillary palpi with the apical segment large, widest at base.

Thorax: longer than broad, surface rugose, sides coarsely punctate. Legs slender, claws toothed, tooth small, basally acute. Elytra rugose, without costae.

Abdomen with the apical segment evenly arcuate.

Pubescence: entirely covered with moderately sparse, moderately long, stout erect white hairs.

Color: dark fuscous with pale testaceous markings. Head pale; antennae rufo-testaceous; thorax pale except for broad indefinite lateral piceous stripe; legs rufo-testaceous; elytra piceous except for indefinite sutural pale stripe and narrow lateral pale stripe; abdomen with basal sternite pale, remainder dark.

Length: 9 mm.

Male genitalia.—(Pl. IX, fig. 35). Median lobe long, slender, sinuate, apex dorsally deflected, apex with a slight knob; base with a long dorsally recurved process and a sub-basal apodeme. Paramere with base stout, dorsally projecting basal plate moderately slender, elongate; apical lobes less than one-half entire length of paramere, apically convergent; base of lobes with slight, but definite dorsal prominence. Tegminite long, slender, apex expanded, arcuate. Ninth abdominal sternite a plate with apex deeply V-shaped emarginate; base truncate with a long basally projecting median process. Tergite a narrow plate, slightly expanded apically, centrally membranous. Eighth abdominal sternite two lobes, thin, apex acute, basally united. Tergite a simple plate, apically arcuate, center membranous. Setae on apex of tegminite, eighth and ninth sternite and tergite.

Allotype.—♀, same data as Holotype.

The female agrees with the male.

Length: 8 mm.

Individual variation.—The coloration of this species is somewhat variable. The sutural pale area is broader in some specimens than that of the type. The punctation and vestiture is constant.

Length: 7-10 mm.

Biology.—On reed seed heads on sand dunes (Valentine).

Distribution.—Known only from Texas, Louisiana and Alabama.

Paratypes: in addition to the type and allotype, the following 39 paratypes are known:

TEXAS: Padre Island, South End, August 31, 1937, (Weed & Perry): 5 ♀, 3 ♂, 1; [CNHM (Field Mus. Exp.)]. Brownsville, Aug. 8, 1937, (D. J. & J. N. Knull): 1 ♂, 1 ♀, [OSU]. Brownsville, July 8, 1941, (W. F. Barr): 1, [Idaho]. Brownsville, (Boca Chica), July 13, 1947, (B. D. Valentine): 4 ♂, 1 ♀, 10, [Valentine].

LOUISIANA: Cameron, July 7, 1905, (Jas. S. Hine): 3 ♀, 4; [OSU].

ALABAMA: Mobile, May 25, 1930, (H. Dietrich): 1 ♂, 1 ♀, [CU]. Dauphin Island, June 10, 1918, (H. P. Löding): 2 ♀; *no further data:* 1 ♀, [Alab.].
No DATA: 1 ♂, [Alab.].

Oxacis (Paroxacis) interrita new species

This species is recognized by the distinct fuscous narrow lateral stripe on the elytra.

Holotype: ♂, Palm Beach, Florida, April 5, 1923, (F. C. Fletcher), [CU].

Head: moderately long, surface very shallowly, indistinctly punctate, surface between puncture rugose. Antennae with each segment six times as long as broad, apex very slightly expanded. Eyes oval, large, very slightly emarginate near insertion of the antennae. Mandibles long, straight, apex acute, convergent. Maxillary palpi with the apical segment broad, widest near base.

Thorax: notum very slightly longer than broad, surface rugose-punctate. Sternum finely rugose. Legs slender, claws with a short, stout tooth at base of each claw. Elytra with the surface rugose, vaguely costate.

Abdomen with the apex of the last sternite evenly arcuate.

Pubescence: entirely covered with fine, short, sparse, golden pubescence.

Color: pale testaceous with fuscous markings. Head pale, with a vague central median longitudinal stripe. Antennae legs and abdomen pale. Thorax pale with a vague central median longitudinal stripe. Elytra pale with a distinct fuscous lateral narrow stripe, slightly wider at the center of the elytra.

Length: 10 mm.

Male genitalia.—(Pl. IX, fig. 34). Median lobe long, slender, dorsally curved, apex acute; base with a stout dorsally recurved process and a stout apically expanded sub-basal apodeme. Paramere with lateral basal, dorsally projecting lobes which are broad at the base, apically narrowing; apical lobes slightly less than one-half the entire length of the paramere, simple, slightly convergent apically, apex blunt. Tegmenite long, broadly expanded apically,

apex emarginate. Ninth abdominal sternite a plate, very deeply emarginate apically; basally broadly V-shaped with a long median basal process. Tergite long, moderately broad, apex arcuate. Eighth abdominal sternite two lobes, basally united, apex of lobe acute, convergent. Tergite a broad plate, apically arcuate, center membranous. Setae present on the apex of the tegminite, ninth and eighth sternite and tergite.

Allotype: ♀, same data as Holotype.

The female exhibits no essential difference from the male, and no sexual dimorphorism.

Length: 13 mm.

Paratypes: The following 59 paratypes are known:

LOUISIANA: Cameron, June 29, 1905, (Jas. S. Hines): 1, [OSU].

FLORIDA: Palm Beach, April 5, 1923, (F. C. Fletcher): 1 ♂, 25 ♀, 1; [CU]. Palm Beach: 2 ♂, 2; [ANSP]. Palm Beach, May 1: 1 ♂, 2 ♀, 9; [RPM]. Kissimmee, 1 ♂, 1; Miami Beach, June 1944, (A. Bacon): 1 ♂, 1 ♀; [AMNH]. Miami Beach, April 30, 1922, (H. B. Bailey): 6 ♂, 2 ♀, 1; Jupier, April 24, (Hubbard & Schwarz): 2 ♂; Miami Beach, April 15, 1918, (T. E. Snyder): 1; Indian River, (Hubbard & Schwarz): 1 ♂; [USNM].

Biology.—Unknown.

Distribution.—Except for one record from Louisiana, this species is confined to the southern part of Florida.

ALLOXACIS Horn

Alloxacis Horn, Proc. Calif. Acad. Sc. (2), 6: 395, 1896.

Genotype: Nacerda dorsalis Melsheimer. [Designated by Lucas, 1920, Cat. Alpha. Gen. Subgen. Coleop., 1: 84.]

The genus *Alloxacis* is unique in that the right mandible only is bifid at the apex. This character is remarkably constant, though in rare cases, it may be so slightly bifid as to be hardly perceivable. The claws are toothed at the base. The male genitalia are very distinct among the species. This genus is most closely related to the genus *Oxacis* LeConte.

Generic features.—Form slender. Head short, eyes very slightly emarginate. Antennae eleven-segmented in both sexes, inserted close to the eyes, apart from the base of the mandibles. Right mandible only bifid at the apex. Maxillary palpi with the apical segment triangular. Claws toothed at the base, tooth usually acute, legs slender. Apex of the apical abdominal sternite not emarginate, no sexual dimorphorism.

Male genitalia.—Median lobe simple, basally with a dorsally curved process and a sub-basal apodeme. Paramere with basal processes extending dorsally and the apex furcate forming two lobes. Tegminite a simple lobe. Ninth abdominal sternite a plate which is deeply emarginate apically and basally with a long median rod. Ninth tergite a simple plate. Eighth abdominal sternite two lobes united by membrane. Eighth tergite a plate which is semi-membranous at the center. (See Pl. IX, fig. 36).

Distribution.—There are thirteen species in the genus; two, (*A. flavipes* Kono from Saipan and *A. geniculata* Klug from Japan are questionable,

and two, (*A. collenettei* Blair and *A. seymourensis Mutchler*) are from the Galapagos Islands. The remainder are from southern United States and Mexico.

KEY TO THE SPECIES

Note: *A. holosericea* Champ. is here based on description only.

1. Claws at most quadrangularly dilated at base; elytra pale, each with two median fuscous vittae attaining the apex ..... *dorsalis* Melsh.
   Claws usually acutely toothed at base, if not, elytra without vittae attaining apex (see *pleuralis*) 2
2. Both thorax and elytra dark, at most with indistinct markings 3
   Thorax pale; elytra usually with vittae 4
3. Body dark, with metallic blue or black reflections ..... *ignota* n. sp.
   Body dark, without metallic reflections, usually with indistinct fuscous or brunneous markings ..... *nitudula* Horn
4. Elytra entirely pale, without vittae ..... *floridana* Horn
   Elytra with vittae or dark 5
5. Each elytron with a median pale vitta extending to apex, rarely somewhat abbreviated 6
   Elytra if with a median pale vitta, never extending beyond middle 7
6. Elytra with distinct costae; thorax with median stripe entire ..... *pseudosericea* n. sp.
   Elytra without costae; thorax with median stripe interrupted at middle ..... *holosericea* Champ.
7. Elytra with a pale median basal vitta which is usually separated from sutural, or if not, does not extend beyond the middle (claws sometimes indistinctly toothed at base) ..... *pleuralis* LeC.
   Elytra without median pale vittae 8
8. Thorax with central dark spot, and lateral spots or stripes; elytra with broad pale sutural vittae ..... *megateles* n. sp.
   Thorax always immaculate; elytra without a sutural stria, or if present, very narrow, rarely broad, if broad, then inner edge sinuate ..... *nesiotes* n. sp.

KEY TO THE MALES

NOTE: *A. holosericea,* and *A. nitidula* are omitted from this key.

1. Apical lobes of paramere short, comprising one-third or less the entire length of paramere 2
   Apical lobes of paramere comprising at least one-half the entire length of paramere 3
2. Apical lobes with stout acute apical hooks; median lobe with an apical recurved hook ..... *pseudosericea* n. sp.
   Apical lobes with fine, apical, laterally projecting setae; median lobe without hooks ..... *pleuralis* LeC.
3. Lobes of paramere greatly enlarged, expanded and heavily pigmented .... *megateles* n. sp.
   Lobes of paramere not large, expanded or heavily pigmented 4
4. Lobes of paramere each with a large hook 6
   Lobes of parameres without hooks 5
5. Median lobe expanded and truncate at apex ..... *nesiotes* n. sp.
   Median lobe expanded and arcuate at apex ..... *ignota* n. sp.
6. Hook about $1/2$ the distance to the apex of the lobe ..... *dorsalis* Melsh.
   Hook at base of lobe ..... *floridana* Horn

ALLOXACIS PLEURALIS LeConte

Probosca pleuralis LeConte, New Species Col., 1: 166, 1866.—Champ., Biol. Centr.-Amer., Col. IV, 2: 153, 1890, (Oxacis).—Horn, Proc. Calif. Acad. Sc., (2), 6: 396, 1896, (Alloxacis).

This species may be usually identified by the short scutellar fuscous stripe. However, this is variable and final identification must depend upon an examination of the male genitalia.

Holotype: Florida, (Mr. Ulke) ♂?. [MCZ (LeC.) type no. 4802].

Head: moderate, very finely punctate, punctures small, shallow and sparse. Antennae eleven-segmented, apical segment ringed at the center; each segment five times as long as broad; each segment very slightly expanded at the apex. Eyes oval, nearly circular, slightly emarginate. Maxillary palpi with the apical segment broadest near the middle.

Thorax: notum only slightly longer than broad; widest near the apex; sides somewhat sinuate; surface finely rugose-punctate. Sternum finely-rugose. Legs slender; claws toothed at the base, tooth blunt at the apex. Elytra finely rugose.

Abdomen: first three sternites finely rugose, apical two more coarsely rugose-punctate; apical segment evenly arcuate.

Pubescence: head and thorax with extremely short, fine, moderately dense white hairs, abdomen with longer, coarse and dense white pubescence.

Color: testaceous with fuscous markings. Head, antennae, legs and abdomen testaceous; thorax testaceous with vague central fuscous spot and four lateral fuscous spots, two on each side; elytra testaceous with a narrow fuscous stripe on humera for entire length, and a short scutellar stripe which converges to the suture.

Length: 11 mm.

Male genitalia.—(Pl. IX, fig. 37). Median lobe a simple lobe, slightly expanded apically, without additional lobe; base with dorsally recurved process, and sub-basal apodeme. Paramere with basal process and short apical lobes, lobes one-fourth the entire length of the paramere, apex of lobes arcuate; basal pieces small. Tegminite a small apically expanded lobe. Ninth abdominal sternite a plate deeply emarginate apically; base angulate with long, basal apodeme. Tergite a plate emarginate basally, apex produced, acute. Eighth abdominal sternite two lobes, apex blunt. Tergite a plate with center membranous. Setae present on the apex of the tegminite, lobes of the paramere and the eighth and ninth sternite and tergite.

Allotype: ♀, same data as holotype.

The female agrees with the male in all respcets.

Length: 8 mm.

Individual variation.—The coloration of this species shows a considerable amount of variation. The pale sutural stripe on each elytron may be broad, nearly one-third the width of the elytra, narrowing and lacking in some specimens. The scutellar stripe is present in all specimens examined except one in the LeConte collection. It extends about one-third the length of the elytra in most specimens and is separate from the sutural except in the case of those with a very broad sutural stripe, in which cases the scutellar stripe merges into the latter close to the base. In rare cases it extends to the center of the elytra or beyond. Claws acutely toothed in most specimens.

Length: 6-9 mm.

Biology.—On reed seed heads growing on sand dunes (B. D. Valentine); on *Croton punctatus* Jacq. (Cameron Co., Texas), (G. B. Vogt).

Distribution.—Virginia, Georgia, Florida, Alabama, Mississippi, Texas, Lower California, and Mexico. It is probably generally distributed throughout the southern part of the United States and Mexico.

Specimens examined.—56: 23 ♂, 13 ♀, 20 sex undetermined.

VIRGINIA: Virginia Beach, July 17, (Hubbard & Schwarz): 1; [USNM].

GEORGIA: *No further data:* 1 ♀, [MCZ (LeC.)].

FLORIDA: Cedar Keys, June 8, (Hubbard & Schwarz): 1, [USNM]. Cedar Keys, June 8: 1, [MCZ (LeC.)]. *No further data:* 1 ♂, (Type no. 4802); 1 ♀ (Allotype), [MCZ (LeC.)]. 1, [ANSP (Horn)]. 1, [CNHM].

ALABAMA: Quilback, (H. P. Löding): 1; Dalphin Island, June 5, 1921: 2; [Alab.]. Mt. Vernon, Mar. 22, 1921, (H. P. Löding): 1 ♀, [Alab.].

MISSISSIPPI: Biloxi, September 1, 1929, (H. Dietrich): 3 ♂, 7; Ocean Springs, June 14, 1931, (H. Dietrich): 15 ♂, 1; Isle of Caprice, Biloxi, June 15, 1931, (H. Dietrich): 1 ♀, [CU].

TEXAS: Kingsville, (C. T. Reed): 1 ♀, 1, [CU]. Padre Island, June 29, 1895: 1 ♀; Houston, June 17, 1895: 1 ♀; Mercedes, October 15, 1939, (Thayer): 2 ♀, (on willow flowers): [USNM]. Brownsville, (Boca Chica), Cameron Co., July 13, 1947, (B. D. Valentine): 1 ♂, 4 ♀, 3, [Valentine Coll.]. *No further data:* 1 ♀, [ANSP (Horn)].

ALLOXACIS FLORIDANA Horn

Alloxacis floridana Horn, Proc. Calif. Acad. Sc., (2), 6: 397, 1896.

This species may be easily distinguished by the uniform fuscous color.

Holotype: Bescayne, Florida, sex? [ANSP (Horn) type no. 8067]

Head: moderate; surface punctate, punctures of moderate size and spaced rather densely. Antennae with the apical segment slightly constricted at the center; each segment four and one-half times as long as broad. Eyes oval, only slightly emarginate. Mandibles thin, acute at the apex; right mandible with a short dorsal tooth. Maxillary palpi with the apical segment widest at the base.

Thorax: notum longer than broad, widest apically; sides somewhat sinuate; surface finely rugose-punctate. Sternum finely rugose. Legs slender, claws acutely toothed. Elytra sub-costate, very finely rugose.

Abdomen: finely rugose, apical sternite evenly arcuate.

Pubescence: entirely covered with short, dense, rather fine pubescence.

Color: entirely brownish-testaceous.

Length: 9 mm.

Male genitalia.—(Pl. IX, fig. 38). Median lobe a simple lobe with a slight apical enlargement, sinuous; basally with a dorsally recurved process and a sub-basal apodeme. Paramere with basal plates extending dorsally, broad; apical lobes slightly less than one-half the entire length of the paramere, convergent apically; base of lobes each with a moderately large dorsal hook. Tegminite long, linear, apex slightly expanded and deflected slightly dorsally. Ninth abdominal sternite a simple plate, apically deeply emarginate, V-shaped, lateral lobes blunt, arcuate at the apex; basally with a long dorsally curved process. Ninth tergite a lobe which is expanded apically and the apex is emarginate; lateral margins chitinized, center semi-

membranous. Eighth abdominal sternite two lobes, apex acute. Eighth tergite a simple plate with the center membranous, apex evenly arcuate. Setae present at the apex of the tegminite, ninth abdominal sternite lobes and the eighth sternite and tergite.

Sexual dimorphism.—None observed.

Individual variation.—Length: 7-9 mm. Coloration is constant with the exception of some darkening along the lateral margins of the thorax and elytra, and a slight darking of the head in one specimen.

Biology.—Unknown.

Distribution.—This species is known from Florida and Alabama.

Specimens examined.—7: 1 ♂, 4 ♀, 2 sex undetermined.

FLORIDA: Dunedin, July 10, 1916, (W. S. B[latchley]. 1 ♀; November 10, 1916: 2 ♀; [CU]. Biscayne Bay: 1, [AMNH]. Biscayne Bay, (Schwarz): 1, [ANSP (Horn type]. *No further data:* (Hubbard & Schwarz): 1 ♂, [USNM].

ALABAMA: D[alphin] Isl[and]: June 5, 1921, 1 ♀, [Alab.].

ALLOXACIS DORSALIS (Melsheimer)

Nacerda dorsalis Melsheimer, Proc. Acad. Nat. Cc., Philad., 3: 55, 1846.—LeConte, Proc. Acad. Nat. Sc., Philad., 7: 21, 1854 (*Asclera*).—LeConte, New Spec. Col., 1: 165, 1866, (*Oxacis*).—Champion, Biol. Centr.-Amer., Col., IV, 2: 155, 1890.—Horn, Proc. Calif. Acad. Sc., (2), 6: 396, 1896, (*Alloxacis*).

Type locality: "Carolina?".

Xanthochroa vittata Haldemann, Journ. Acad. Nat. Sc., Philad., (2), 1: 96, 1848 [*X. vittata* Hald. placed as syn. *A. dorsalis* Mels.].—LeConte, Proc. Acad. Nat. Sc., Philad., 7: 21, 1854.

Type locality: "New Orleans?".

The quadrangularly dilated basal tooth of the claws and the pale testaceous elytra with fuscous vittae serve to readily separate this species from the others of the genus.

Male.—Orlando, Fla., July 1927, (M. D. Leonard), [CU].

Head: moderately short, distinctly, coarsely, and densely punctate, gula base. Antennae with the apical segment slightly constricted at center; each segment six times as long as broad, each slightly expanded apically. Eyes elongate oval, moderate in size, slightly emarginate. Mandibles thin, acute, right mandible with a short dorsal tooth which does not attain the apex.

Thorax: notum large, somewhat longer than broad, widest towards the apex; sides slightly sinuate; surface very finely rugose. Sternum finely rugose. Legs slender, claws quadrangularly dilated at the base, not acutely toothed. Elytra finely rugose-punctate, costate.

Abdomen finely rugose; apical sternite evenly arcuate.

Pubescence: head and thorax with extremely fine, short, whitish moderately dense pubescence. Abdomen and elytra with somewhat longer and coarse pubescence.

Color: pale testaceous with fuscous markings. Head pale with a median, moderately broad, fuscous stripe. Antennae and legs pale. Thorax pale with a median stripe in continuation with that of the head. Elytra pale with each elytron with two narrow fuscous stripes, contiguous apically.

Abdomen with the first sternite pale, part of the second and all of the third to fifth pale piceous.

Length: 15 mm.

Male genitalia.—(Pl. X, fig. 40). Median lobe large, curved, base with dorsally recurved process and a sub-basal apodeme; apex abruptly narrowed with a small apical lobe deflected dorsally, apex expanded before lobe. Paramere with the base expanded; apex with lobes one-half the entire length of the paramere; apical hooks one-third the length of the lobe. Base with long narrow process from each basal-lateral plate. Tegminite a small lobe, apex slightly expanded and arcuate. Ninth abdominal sternite a plate, the apex of which is deeply emarginate forming two blunt lateral lobes. The base has a long dorsally curved process. The ninth tergite is a large plate, base arcuate-acute, narrow. Eighth abdominal sternite two large lobes joined by chitin at the base, apex of each lobe acute; lobes converging apically. Eighth tergite an apically emarginate plate, btse truncate. Setae present on the apex of the tegminite, ninth sternite and eighth sternite and tergite.

Female.—Ocean Spring, Mississippi, May 30, 1931, (H. Dietrich), [CU].

The female agrees with the male, exhibiting no sexual dimorphism.

Individual variation.—Length: 8-14 mm. The fuscous stripes of the elytra are often interrupted at the middle, but always present.

Biology.—Larvae abundant in dirt and wood.

Distribution.—This species is known from the Atlantic coast from Long Island south through Florida and west to Brownsville, Texas and south into Mexico.

Specimens examined.—194: 26 ♂, 23 ♀, 145 sex undetermined.

NEW YORK: Vicinity of N. Y. C.: 2, [AMNH]. New Windsor, June 1885: 1; Staten Is.: 1 ♂, [USNM]. Long Beach, L. I.: 5; Staten Is.: 2, [AMNH]. Rockaway Beach, L. I.: July 18, 1911: 2 ♂, 2 ♀; Sept. 1, 1902: 2 ♂; [RPM].

NEW JERSEY: Peck's Beach, July 1895: 3 ♂; Anglesea: 4 ♂; [CU]. Highlands: 44; Newark: 4; Longport: 3; Anglesea, Aug. 13, (Geo. M. Green): 1; [USNM]. Avalon: 2; [AMNH]. Longport, (G. M. Green): 1 ♀, [Alab.]. Sandy Hook: 29; Anglesea: 2; Seashore: 1; [AMNH]. Anglesea: 2 ♀, [RPM]. *No further data:* 1, [CNHM].

MARYLAND: Chesapeake Beach, July 28: 15; Piney, (Hubbard & Schwarz): 1, [USNM].

VIRGINIA: Ft. Monroe, (Hubbard & Schwarz): 1; *no further data:* 4; [USNM] Hamproe June 25, 1944: 1 [Mackenzie].

NORTH CAROLINA: Cape Fest, Smith Island, April 1, 1934, (H. S. Barber): 1, [USNM].

GEORGIA: St. Simon's Island, June 4, 1911: 3 ♂, 1 ♀, 3; [CU]. Chatham Co., June 1928: 1; [AMNH]. Tybee Island: 1; [CNHM]. Tybee Island: 6; [USNM]. Tybee Island: 3 ♂, 7 ♀; [RPM]. *No further data:* 1 ♂, 3 ♀, [MCZ (LeC.)].

FLORIDA: Palm Beach, May 1: 3 ♀, [RPM]. Orlando, July 1927, (M. D. Leonard): 1 ♂, [CU]. Enterprise, May 14: 2; S. Baco Grande, May 23, 1919: 1, [USNM]. Mayport, June 10, 1921: 1, [AMNH].

ALABAMA: Dalphin Island, May 18, 1913: 5; June 10: 1 ♂, 1 ♀, [Alab.]. Dalphin, July 15-18, 1 ♂, 1 ♀, [CU].

MISSISSIPPI: Ocean Springs, May 30, 1931, (H. Dietrich): 2 ♀, [CU].
TEXAS: Galveston: 2; Brownsville: 3; [USNM].
SOUTHERN STATES: *No further data:* 2 ♂, [MCZ (LeC.)]
NO DATA: (Sherman): 1 ♂, [CU].
[Specimens in the Horn Collection, (ANSP) from Georgia and New Jersey.]

ALLOXACIS NITIDULA Horn

Alloxacis nitidula Horn, Proc. Calif. Acad. Sc., (2), 6: 396, 1896.

This species is entirely dark and resembles *A. ignota* n. sp., but may be distinguished from the latter species by the lack of metallic reflections in the coloration and by the distinctive male genitalia.

Lectotype: sex?, Lower California, [CAS (type No. 142)].

Female.—Lower California, 19 mi. E. Rosario, June 17, 1938, (Michelbacker & Ross), [CAS].

Head: moderate, very finely punctate-rugose. Antennae with each segment five times as long as broad, each segment very slightly expanded apically. Eyes large, oval, nearly circular, very slightly emarginate. Mandibles thin, acute at the apex, right mandible with a short dorsal tooth not attaining the apex. Maxillary palpi with the apical segment moderately broad, broadest near the center.

Thorax: notum slightly longer than wide, widest towards the apex, sides feebly sinuate; surface finely rugose. Sternum moderately rugose. Legs slender, claws acutely toothed. Elytra finely rugose punctate.

Abdomen: finely rugose-punctate, apical sternite evenly arcuate.

Pubescence: covered with short, dense, moderately coarse, whitish hairs.

Color: piceous except legs, front, antennae and mouthparts which are pale.

Male.—Unknown.

Individual variation.—Length: 7-9 mm. The thorax of some specimens examined showed very faint fuscous lateral stripes.

Biology.—Unknown.

Distribution.—California and Lower California.

Specimens examined.—7 ♀.

CALIFORNIA: San Pedro Bay Gulf, July 7, 1921, (E. P. VanDuzee): 2 ♀; [CAS]. *No further data:* 2 ♀, [ANSP (Horn)].
LOWER CALIFORNIA: 19 mi. East of Rosario, June 17, 1938, (Michelbacker & Ross): 1 ♀, [CAS]. Sierra San Lazaro: 1 ♀, [ANSP].
NO DATA: 1 ♀, [ANSP].

Alloxacis megateles new species

This is one of the most distinct species of the family genitalically, yet not easily distinguished by gross morphological features. The coloration, resembling that of *A. pleuralis*, is variable but distinct, and the species may usually be separated on color characters alone. The elytra are dark with a broad pale sutural stripe. The thorax is pale with two large lateral spots

and a central dark marking which may vary from a small central spot to two large central spots, the anterior one elongate and the posterior one smaller and circular. The head is pale. The male genitalia are so distinctive that they may be readily identified without dissection if exserted because of the greatly enlarged lobes of the paramere. These lobes are dark and heavily chitinized. No other species of the family known to me exhibits this character.

Holotype: ♂, Summerland Keys, Florida, July 24, 1940, (J. C. Bradley), [CU type no. 2416)].

Head: short, broad; punctation shallow, nearly rugose-punctate. Antennae with eleven segments, each segment round, linear, about five times as long as broad. Eyes large, oval, very slightly emarginate. Mandibles acute at apex, thin, right mandible with a short dorsal tooth not attaining the apex. Maxillary palpi four segmented, apical segment triangular, broadest near the base.

Thorax with the notum slightly broader than long, sides sinuate, broadest towards apex, surface minutely rugose. Sternum sparsely punctate rugose. Legs slender, fourth segment only spongy beneath on fore and middle legs, third on hind legs. Claws acutely toothed. Elytra slightly costate, fine punctate, somewhat rugose.

Abdomen with five visible sternites, rugose punctate, depressions shallow and minute.

Entire insect clothed in very fine, moderately sparse, short white hairs which become denser and longer on the elytra and abdomen.

Color: testaceous; the following piceous: maxillary palpi; antennae; thorax two broad lateral stripes and a small central anterior spot; tibia and tarsi; elytra except for broad sutural testaceous stripe; abdomen except for basal sternite; lobes of the paramere.

Length: 7 mm.

Male genitalia.—(Pl. X, fig. 41). Median lobe a simple lobe which is enlarged apically, narrowing to an arcuate apex. Base with a dorsally recurved process and a large apically expanded sub-basal apodeme. Paramere basally with two dorsally projecting, expanded lobes; apically with two large, heavily chitinized, expanded lobes, apex of which are arcuate with an internal emargination, internally pale and texture of a softer appearance. Tegminite a simple long, linear lobe slightly expanded apically. Ninth abdominal sternite a simple plate with two lateral, apically projecting blunt lobes and with a long basally projecting, dorsally curved apodeme. Ninth tergite a simple plate, apex of which is arcuate and base truncate. Eighth abdominal sternite two lobes united at the base by chitin, extreme base membranous. Eighth tergite a simple plate, arcuate at the apex, truncate at base. Setae present on the apex of tegminite; apex of ninth sternite lobes; apex of eighth sternite and tergite.

Allotype: ♀, Dry Tortugas, June 26, 1936, (H. H. Plough), [CU].

The female agrees with the male in all respects. No sexual dimorphism exhibited.

In addition to the types, I have seen fifty-nine paratypes as follows: FLORIDA: Summerland Keys, July 24, 1940, (J. C. Bradley): 23 ♂; [13 in CU; 10 Author]. Jupiter, May 6-7: 2 ♂, 1 ♀, 2; June: 1 ♂; Palm Beach, May 1: 1 ♀, [RPM]. Matacumba Key, July 24, 1940, (J. C. Bradley): 1 ♂; [CU]. Biscayne Bay: 1 ♀; Palmetto Key, June 18-26, 1942, (C. M. Breder): 1; Dry Tortuga: 2 ♂, 1 ♀, 1; [AMNH]. Miami Beach, April 30, 1922, (H. B. Bailey): 12 ♂, 3 ♀; Capron, July 25, (Hubbard & Schwarz): 1 ♂; Estero, May 6-12, 1908, (VanDuzee): 1 ♂; Key West, June 17-July 1, (H. F. Wickham): 1 ♂, 1; Miami, May 16, 1916, (T. E. Snyder): 1; [USNM]. Key Largo, May 13, 1939, (J. N. & D. J. Knull): 1 ♂, [OSU].

Individual variation.—The size and the coloration of the thorax are the only variable characters observed in this species.

Length: 6-10 mm.

Biology.—One specimen bears a label stating that the specimen was caught in flight. Nothing is known of its food plant or habits.

Alloxacis pseudosericea new species

The elytra with a pale sutural and a central vitta and the thorax with a central and two apical piceous stripes are spot characters for this species. The paramere of the male is distinctive by having each apical lobe with a stout dorsally projecting hook. On external appearance, this species resembles the Mexican species *A. holosericea* Champion.

Holotype: ♂, Capron, Florida, (Hubbard & Schwarz), [USNM, Cat. no. 58979].

Head: somewhat elongate, surface distinctly, but sparsely punctate, punctures small. Antennae eleven-segmented, apical segment somewhat ringed at the center; each segment four and one-half times as long as broad, each segment somewhat expanded apically. Eyes moderately large, oval, slightly emarginate. Mandibles narrow, apex acute, right mandible with a short tooth which does not reach the apex. Maxillary palpi four-segmented, not so elongate, apical segment broadest apically.

Thorax: notum no longer than broad, broadest apically, sides sinuate, surface finely rugose-punctate. Sternum finely rugose. Legs slender, claws all toothed, tooth acute. Elytra costate, rugose punctate.

Abdomen: five visible sternites, apical sternite not produced, sub-truncate; surface finely rugose.

Pubescence: head with sparse, fine short white hairs; thorax with dense, short, fine white hairs; elytra and abdomen with dense, coarse, longer white hairs.

Color: piceous; the following pale testaceous: elytra with a narrow sutural stripe and each with a narrow central stripe which narrows towards and reaches the apex; thorax except for a central and two lateral narrow piceous stripes; head and mouth parts; femora.

Length: 9 mm.

Male genitalia.—(Pl. IX, fig. 39). Median lobe a simple lobe with a basal dorsally recurved process and a sub-basal apodeme; apex with a small

ventral hook. Paramere with base expanded, apex furcate, lobes short about one-sixth the entire length of the paramere and with a stout dorsally projecting hook at the apex of each. Tegminite a long, linear simple lobe slightly expanded apically, apex arcuate. Ninth abdominal sternite a simple plate with two lateral, small apically projecting blunt lobes and with a long basally projecting, dorsally curved apodeme. Tergite a simple plate, apex of which is arcuate and base truncate. Eighth abdominal sternite two lobes united at the base by chitin, extreme base membranous. Tergite a simple plate, arcuate at the apex, truncate at the base. Setae present on the apex of the paramere lobes, the tegminite, and the eighth and ninth sternite and tergite.

Allotype: ♀, Crescent City, Florida, (Hubbard & Schwarz), [USNM, Cat. no. 58979].

The female agrees with the male in all respects. No sexual dimorphism exhibited.

Length: 10 mm.

In addition to the types, the following six paratypes are designated: FLORIDA: Crescent City, (Hubbard & Schwarz); 1 ♀, 1 ♂, 2; Hilsboro Co., (Hubbard & Schwarz): 2 ♂; [USNM]. All types deposited in the United States National Museum.

Individual variation.—The central pale stripe on each elytron in some cases becomes very indistinct towards the apex, but is definite beyond the center in every case. Some specimens have the antennae pale, not piceous. The length varies from 8-10 mm.

Biology.—Unknown.

Additional specimens examined.—FLORIDA: Tampa: 1 ♂; [MCZ (LeC.), (no. 1382 on pin)]; Palm Beach: 1 ♂, 3, [ANSP].

Alloxacis nesiotes new species

A rather difficult species to place until the male genitalia have been examined, this species is separated from the others of the genus by the immaculate thorax, the dark elytra without central vittae and usually without prominate sutural pale stripe, or if the sutural area is pale, it is not a definite stripe but rather a vaguely defined pale area. The male paramere is distinctive in that the base is very large and expanded while the apical lobes are short and bear many fine setae.

Holotype: ♂, Key West Florida, June 4, 1905, (F. Knab), [USNM Cat. no. 58932].

Head: moderately short, surface finely rugose-punctate. Antennae eleven-segmented, apical segment constricted at the center. Eyes large, oval and very slightly emarginate. Mandibles thin, acute at apex, right mandible with a short dorsal tooth which does not attain the apex. Maxillary palpi four-segmented, apical segment long and narrow, acute at apex, widest at the base.

Thorax: notum slightly longer than broad, broadest at apex, sides sinuate,

surface finely rugose punctate. Sternum finely rugose-punctate. Legs slender, all claws toothed, tooth small, acute at the apex. Elytra vaguely costate, rugose-punctate.

Abdomen with apical sternite evenly arcuate, surface finely rugose-punctate.

Pubescence: all fine, moderate in length, moderately dense, white, silky.

Color: piceous: the following pale testaceous: head, antennae, thorax, legs, very narrow sutural stripe. Abdomen paler than the elytra, but not testaceous.

Length: 6 mm.

Male genitalia.—(Pl. X, fig. 42). Median lobe a simple lobe with a pronounced apical expansion, apex truncate, base with dorsally recurved process and a sub-basal apodeme. Paramere with base greatly expanded, emarginate, lobes short, dorsally curved. Tegminite long, linear, apex expanded. Ninth abdominal sternite a simple plate with two lateral, apically projecting blunt lobes and with a long basally projecting dorsally curved apodeme; apex of lobes with very long, moderately stout setae. Ninth tergite a simple plate, apex of which is arcuate and base truncate. Eighth abdominal sternite two lobes united at the base by chitin, extreme base membranous. Eighth tergite a simple plate, arcuate at the apex, truncate at the base. Setae present at the apex of: the paramere lobes, tegminite, eighth and ninth sternite and tergite.

Allotype: ♀, Key West, Florida, June 20, 1902, (F. Knab), [at light], [USNM].

The female agrees with the male in all respects except that it is paler and the sutural pale area is broader, broadest near the base.

Length: 8 mm.

In addition to the types, the following forty-two paratypes have been studied:

FLORIDA: Key West, June 20, 1902 [At light]: 2 ♂, 4 ♀; June 4, 1905, (F. Knab): 8 ♂, 2 ♀, 11; April, (Hubbard & Schwarz): 1, [USNM]. Dry Tortuga, (J. Thompson): 2 ♀, 1, [AMNH].

BAHAMAS: Eleuthera, July 9-15, (Wickham): 4; [USNM, Paratype No. 58932 (Casey Coll.)].

Individual variation.—The length varies from 6-9 mm. The coloration of the elytra is variable. Some specimens are pale, nearly brown in color and the sutural pale area may be absent to moderately broad.

Biology.—This species, known only from island material, was collected at light by F. Knab. Nothing else is known of its habits.

Alloxacis ignota new species

This dark colored species resembles *A. nitidula* in external appearance. It may be separated by the metallic reflections of the body and the absence of dark brown markings. The notum is distinctly but sparsely punctate in

this species, the punctures moderate in size, while *A. nitidula* has the surface of the notum finely rugose-punctate.

Holotype: ♂, Capron, Florida, (Hubbard & Schwarz), [USNM Cat. no. 58980].

Head: slightly elongate; surface distinctly, but sparsely punctate, punctures moderate. Antennae eleven-segmented, apical segment slightly constricted at the center; each segment five times as long as broad. Eyes moderately large, oval, very slightly emarginate. Mandibles thin, acute at the apex, right mandible with a short dorsal tooth which does not attain the apex. Maxillary palpi four-segmented, apical segment broadest at the center, apex not acute.

Thorax: notum longer than broad, sides sinuate, broadest apically, surface punctate, punctures large, not close. Sternum punctate as the notum. Legs slender: claws toothed, tooth short, almost quadrate. Elytra somewhat costate, rugose-punctate.

Abdomen: with five visible sternites; apical sternite evenly arcuate; surface rugose-punctate.

Pubescence: head with moderately thick, fine, short, white pubescence. Thorax with longer, elytra with denser and longer, and abdomen with fine and sparse pubescence.

Color: piceous except the following testaceous; mouthparts, antennae and legs.

Length: 8 mm.

Male genitalia.—(Pl. X, fig. 43). Median lobe with the apex expanded without additional lobe, evenly arcuate; base with a dorsally recurved process and a sub-basal apodeme. Paramere: base with narrow dorsally projecting lobes; apex with two long lobes which are nearly one-half the length of the paramere; lobes without hooks. Tegminite a simple lobe somewhat expanded at the apex. Ninth abdominal sternite a plate, apex deeply emarginate, V-shaped, base wtih a long basal rod. Ninth tergite a simple plate truncate at the base, tapering to a blunt apex. Eighth sternite a simple plate with center membranous. Setae present on the apex of the tegminite, eighth and ninth sternite and tergite.

Allotype: ♀, Lake Worth, Florida, (Hubbard & Schwarz), [USNM, Cat. no. 58980].

The female agrees with the male in all respects.

Length: 6 mm.

In addition to the types, the following twenty-three specimens have been examined and designated as paratypes:

FLORIDA: Dry tortugas, June 7-13, 1933, (Wickham): 1 ♂, 1 ♀; Capron, (Hubbard & Schwarz): 2 ♂; St. Lucie Ind., (Hubbard & Schwarz): 1 ♂; *no further data*, (Hubbard & Schwarz: 1 ♀, [USNM]. Miami, (H. F. Strohecker): 1 ♂, 1 ♀, [CAS].

GEORGIA: St. Simon's Island, July 12, 1931, (C. F. Frost): 2 ♂, [CAS]. Savannah, (G. Noble): 1 ♂, 2 ♀, 1; *no further data:* 1 ♂, 1 ♀, [USNM]. Tybee Island, June 23-July 4: 1 ♂, 3 ♀, 3, [RPM].

Individual variation.—Two specimens examined show a fuscous cast rather than the metallic blue-green reflections.

Length: 5-8 mm.

Biology.—Unknown.

ALLOXACIS HOLOSERICEA Champion

Oxacis holosericea Champion, Biol.. Centr.-Amer., Col., IV, 2: 152, 1890.—Horn, Proc. Calif. Acad. Sc., (2), 6: 396, 1896.

Type locality.—Mexico.

This species appears to be very close to *pseudosericea*, n. sp., but may be separated, judging from the description, by the absence of elytral costae. I know it only from Champion's description and figure in his monograph.

Head: closely and finely punctate. Antennae with the eleventh joint constricted at the middle in both sexes.

Thorax: longer than broad, convex, sides a little rounded before the base; densely and minutely punctured. Claws toothed. Elytra densely and minutely punctate without costae.

Abdomen: densely and minutely punctured.

Pubescence: densely clothed with very fine silky cinereous pubescence.

Color: in general testaceous or pallid testaceous with black markings. Head pale with the eyes and tips of the mandibles black. Antennae testaceous, basal joints slightly stained with piceous. Thorax with a broad median stripe interrupted at the middle and side with broad stripe.

Male genitalia.—Unknown.

Sexual dimorphism.—Unknown.

Biology.—Unknown.

Distribution.—Three specimens known, 1 ♂ and 2 ♀ from Mexico: Acapulco (Höge), and Tres Marias Island, (Forrer).

ASCLERA Stephens

Asclera Stephens, Man. Brit. Col., 336, 1839.—LeConte, Classif. Col. N. Amer., 259, 1862.—LeConte & Horn, Classif. Col. N. Amer., ed. 2, 405, 1883.—Horn, Proc. Calif. Acad. Sc., (2), 6: 404, 1896.

Genotype: Necydalis sanguinicollis Fab. [Designatedby Arnett, 1950, p. 219.]

This is a large genus widely distributed throughout the world, of which there are six North American species. The members of this genus are related to the genera *Copidita* and *Rhinoplatia*. They may be easily distinguished by the toothed claws and by having the mandibles both bifid apically. The elytra are usually costate.

Generic diagnosis.—Head short. Antennae eleven-segmented in both sexes, inserted between eyes and base of the mandibles. Both mandibles bifid at the apex. Last joint of the maxillary palpi triangular. All claws toothed at the base. The apical abdominal sternite produced in both sexes. No sexual dimorphism.

Male genitalia.—Median lobe long, slender, straight, basal portion rarely

stout; base with a long recurved dorsal process, the apex of which is expanded; sub-basal apodeme long, well chitinized. Paramere basally with large dorsally projecting plates, apex furcate, forming two long slender lobes. Tegminite a simple lobe, usually long, slender. Ninth abdominal sternite a plate with lateral dorsal extension and a long basal process. Ninth tergite, a narrow elongate plate, somewhat membranous at center. Eighth sternite two stout lobes united at the base by chitin. Eighth tergite a simple plate arcuate at the apex, base truncate, membranous.

Distribution.—Three species are confined to the western part of the United States, mainly in the Rocky Mountain area. Two species are found in the east only, the remaider are distributed throughout North America.

Nomenclatorial notes.—As explained under the genus *Xanthochroa* the species described as *Asclera erythrocephala* Germar is here removed and associated with that genus.

KEY TO THE SPECIES

1. Elytra basally yellow, blending to black at apex ..... *discolor* LeC.
   Elytra dark 2
2. Head and thorax black ..... *nigra* L. C.
   Thorax orange 3
3. Thorax with central black spot ..... *puncticollis* Say
   Thorax at most only slightly darkened at center 4
4. Thorax impunctate except for a row at base ..... *ruficollis* Say
   Thorax punctate or rugose 5
5. Elytra black or blue; thorax rugose or punctate ..... *excavata* LeC.
   Elytra with golden vestiture; thorax densely punctate ..... *auripilis* VanDyke

KEY TO MALES

1. Median lobe with two stout apical, ventral hooks; ninth tergite large, conspicuously Y-shaped ..... *puncticollis*
   Median lobe without hooks; ninth tergite small, not Y-shaped 2
2. Median lobe long, enlarged at the apex, hastate ..... *nigra* LeC.
   Median lobe shorter, not enlarged at the apex 3
3. Recurved base of median lobe triangularly expanded 4
   Recurved base of median lobe trapezoidal in shape, sides parallel 5
4. Base of triangle only slightly emarginate ..... *ruficollis* Say
   Base of triangle deeply emarginate ..... *auripilis* VanDyke
5. Tegminite short, no longer than the ninth tergite ..... *discolor* LeC.
   Tegminite long, much longer than the ninth tergite ..... *excavata* LeC.

ASCLERA RUFICOLLIS (Say)

Oedemera ruficollis Say, Journ. Acad. Nat. Sc., Philad., 3: 271, 1823.—Haldem, Journ. Acad. Nat. Sc., Philad., (2), 1: 96 1848.—LeConte, Compl. Writ. T. Say, 2: 160, 1859.—Horn, Proc. Calif. Acad. Sc., (2), 6: 407, 1896, (Asclera).

Type locality: "Missouri nr. Rocky Mts."

Oedemera carinata Newman, Ent. Mag., 5: 378, 1838.—Haldem., Journ. Acad. Nat. Sc., Philad., (2), 1: 96, 1848 (*O. carinata* Newn., placed as syn. of *ruficollis* Say.).—LeConte, Proc. Philad. Acad. Nat. Sc., 7: 21, 1954.

Type locality: Trenton Falls, N. Y.

This is a very common species in northeastern United States. It may be

identified by the orange thorax and the piceous elytra with pronounced costae. Thorax without punctures.

Male.—Ithaca, New York, May 17, 1938, (J. G. Franclemont), [Author].

Head: short, surface closely and coarsely punctate. Antennae with the apical segment constricted at the center; segments very slightly wider at the apex. Eyes very slightly emarginate, protruding. Mandbiles both distinctly bifid at apex, slender. Maxillary palpi with the apical segment large, triangular, broadest at base.

Thorax: notum broader than long, widest at apex, sides sinuate, very finely rugose, appearing granular, a short transverse row of punctures at the base. Sternum very finely rugose. Legs slender, claws with a stout, acute tooth about one-fourth the length of the claw. Elytra rugose, prominently costate, costae 2 and 3 united at the base.

Abdomen: apical sternite truncate and produced at the center; surface finely rugose.

Pubescence: entirely covered with fine, short, whitish vestiture, longest on venter of abdomen and base of antennae.

Color: black with orange markings. Head black, mouth-parts somewhat testaceous. Antennae black with basal two and one-half of third segments partly testaceous. Thorax orange, legs black, elytra piceous. Abdomen black.

Length: 7 mm.

Male genitalia.—(Pl. XI, fig. 47). Median lobe long, slender, apex acute, slightly expanded before the apex; base with long, recurved dorsal process which is expanded apically, expanded portion broadly V-shaped, apex broadly emarginate. Sub-basal process slender. Paramere base with expanded dorsally projecting plates, base deeply emarginate, apical lobes very long and slender, acute at apex. Lobes two-thirds of the entire length of the paramere. Tegminite long, stout, apex acute, slightly broadened near the center. Ninth abdominal sternite a plate latero-dorsally curved; margins contiguous dorsally; truncate, apex emarginate. Long basal dorsally curved process present. Ninth tergite long, very narrowly V-shaped. Eighth abdominal sternite two lobes united at the base, base membranous. Eighth tergite an apically arcuate plate with center membranous. Setae at the apex of the tegminite and the eighth abdominal sternite and tergite.

Female.—Same data as male.

The female agrees with the male in all essential respects.

Individual variation.—The coloration and sculpture of this species is nearly constant in all specimens examined, except that in some the elytra are less markedly costate than the typical forms.

Length: 5-8 mm.

Biology.—This species is common on the flowers of yellow adder's tongue or dog's tooth violet (*Erythronium americanum* Ker.); also on the flowers of willow, wild plum, black haw, etc.

Distribution.—This species is recorded from Quebec and Ontario southward through Alabama, (Horn reports it from Texas) and westward through Ohio, Indiana with one record from Nebraska.

Specimens examined.—214: 74 ♂, 45 ♀, 95 sex undetermined.

QUEBEC: Montreal: 4, [CNHM]. Montreal: 2 ♂, 1 ♀, [Alab.]. La Trappe, May 27, 1937, (J. Ouellet): 1 ♀, [Mackenzie].

ONTARIO: Toronto, April 27, 1895: 1 ♂, 1; April 28, 1895: 1 ♂; April 13, 1895: 1 ♂; *no further data:* 1; (Chas Palm): 1, [CU]. Prince Edward Co., May 5, 1918: 1 ♂, [RPM].

NEW YORK: Poundridge, July 5, 1930, (L. Lacey): 1; Bronxville, May 2, 1914, (L. B. Woodruff): 1; Ramapo Mts.: 2; Fort Lee Dist.: 2; Greenwood Lake, May 17, 1914: 3; Suffern, May 2, 1915, (F. M. Schott: 1; Ft. Montgomery, May 25, 1913, (F. M. Schott): 2; Bronxville, April 24, 1911: 6; Wading River, L. I., May 31, 1914: 1; West Point, May 7, 1911, (W. Robinson): 1; Suffern: 1, [AMNH]. Ithaca, May 3, 1914: 3 ♂, 1 ♀; April 29, 1933: 1 ♂; April 12, 1890: 2 ♂, 1 ♀, 1; May 22, 1934: 1; May 1, 1940, (W. D. Wylie): 1 ♂; April 20, 1895: 2 ♂, 2; May 30, 1895: 1; April 21, 1895: 1; May 17, 1914: 1 ♂; 1 ♀; May 15, 1914: 1; May 8, 1915: 1 ♀; May 22, 1914: 1; May 13, 1933: 1 ♀; Heart Lake, Essex Co., June 28, 1940: 1 ♀; June 20, 1941: 1 ♀; top Mt. MacIntyre, July 29, 1940: 1; Peterson, May 29, 1935: 2 ♀; Oliverea, June 18, 1934: 1 ♂, 1 ♀, 1, (*all* H. Dietrich); Lockport, May 11, 1935, (L. L. Puchuman): 1 ♂; McLean, May 8, 1891: 2 ♂; Fall Creek, Ithaca, April 26, 1925, (Babiy): 1 ♂; Lake Keuka, April 28, 1900, (C. R. Crosby): 1 ♀; top Mt. Whiteface, June 27, 1941: 3 ♀, 4; June 11, 1942; Newfield, May 21, 1940: 1 ♂; Side Mt., Ulster Co., July 13, 1940: 2 ♀, 1; Heart Lake, Essex Co., July 30, 1940: 1 ♂, (*all* H. Dietrich); Ithaca, Taughanic, April 21, 1917, (Shannon): 1 ♂; (H. Dietrich): 1 ♂; Mahopac Falls, May 11, 1936, (L. L. Pechuman): 1 ♀; Patterson. April 24, 1935: 3 ♀; Oswego, April 24, 1935: 1 ♂, (*all* H. Dietrich); Yonkers, May 2, 1937, (L. L. Pechuman): 1 ♀; McLean, May 29, 1915: 1; Ithaca, May 4, 1919, (H. Dietrich): 1 ♂; McLean Bogs, Tompkins Co., May 30, 1914: 1 ♂; *no further data*: 1 ♂; June: 1 ♂, 1 ♀, [CU]. Yaphank, L. I., May 20, 1912, (G. P. Englehardt): 2 ♀, [RPM]. Vicinity of N. Y.: 2; *no further data:* June 19, 1918: 1 (sweeping); 5, [AMNH]. Ithaca, April 20, 1941: 3 ♂, 1 ♀; May 8, 1941: 1 ♂; April 25, 1941: 1 ♂; April 29, 1941: 4 ♂, 1 ♀; May 17, 1938: 4 ♂, 2 ♀; May 19, 1934: 1 ♂; May 15, 1933: 2 ♀; May 10, 1938: 1 ♀, (*all* J. G. Franclemont); Ithaca, Six Mile Creek, April 27, 1923, (L. S. West): 1 ♂, 1 ♀; Ithaca, April 26, 1896: 1 ♂, 1 ♀; May 3, 1914: 1 ♂, [Author]. Pike, Wyoming Co., June 4, 1900, (J. C. Warren): 2 ♂, 1, [USNM]

NEW HAMPSHIRE: Mt. Washington: 1; Franconia: 1 [AMNH].

MASSACHUSETTS: Melrose High., April 23, (D. H. Clemons): 1 ♂, 1 ♀, [USNM]. Framingham, May 11, 1944, (C. A. Frost): 1 ♂, [CU]. Boston: 2; Brookline: 1 [AMNH].

CONNECTICUT: Lyme: 3 ♂, 2, [USNM].

PENNSYLVANIA: Milford, Pike Co., May 30-June 1, 1941, (B. Malkin): 2 ♂, 1 ♀, [Malkin]. Arcola, April 25: 2 ♀; Lancaster Co., June 1: 4 ♂, [RPM].

OHIO: Lancaster: 5; *no further data:* 1, [USNM]. Columbus, March 25, 1930, (B. B. Pepper): 1 ♂; Delaware Co., March 25, (D. J. & J. N. Knull): - ♂; April 2: 1 ♂; Cantwell Cliffs, April 20, 1935, (R. C. Osburn): 1 ♂, [OSU]. Hudson, June 20: 1 ♀, [RPM].

INDIANA: Perry Co., May 23, 1908, (W. S. Blatchley): 1 ♂, 1, [CU].

ILLINOIS: Bloomington, May 30, 1917: 3; Willow Springs, Cook Co.: 3; Edgebrook, May 15, 1917: 1, [CNHM]. *No further data :* 1, [AMNH].

MICHIGAN: Muskegon, May 18, 1907: 1, [CNHM]. Gladwin Co., May 18, 1940, (R. R. Driesbach): 1 ♂; Midland Co., May 5, 1940. (R. R. Driesbach): 1 ♂, 1 ♀, [Mackenzie].

IOWA: Iowa City, April 22, 1917, (Lindsey): 1, [USNM]. Lee Co.: 1 ♂, [RPM].

MARYLAND: Opposite Plummer's Island, April 18, 1916, (A. H. Pottinger): 1, [USNM].

DISTRICT OF COLUMBIA: Washington, April 18, 1934, (J. C. Bridwell): 1 ♂, 1 ♀, [USNM].

VIRGINIA: Thorofore Gap, April 23, 1935: 1 ♂; Read Run, Fairfax Co., March 26, 1925, (R. C. & E. M. Shannon): 1 ♂, [USNM].

WEST VIRGINIA: Mannington, April 20, 1933: 1 ♂, [CU].

ALABAMA: Colbert Co., June: 1 ♀, [Alab.]. *No further data:* April 12, 1923: 1, [AMNH].

CANADA: *No further data:* 5, [CNHM].

EASTERN STATES & CANADA: *No further data:* [ANSP (Horn)].

MIDDLE STATES: *No further data:* 1 ♂, [ANSP (Horn)].

SOUTHERN STATES: *No further data:* 1 ♀, [ANSP (Horn)].

Also in Horn collection are specimens from Ohio, Pennsylvania, North Carolina, New Hampshire and Virginia.

ASCLERA EXCAVATA LeConte

Asclera excavata LeConte, Ann. Lyc. Nat. Hist., N. Y., 5: 158, 1852.—Horn, Proc. Calif. Acad. Sc., (2), 6: 407, 1896.

This species is very closely related to the preceding, but may be separated from it by the rugose thorax and the less prominently costate elytra and differences in the male genitalia.

Holotype: ♀, San Diego, California (gold disc), [MCZ, (LeC.), type no. 4804].

Head short, surface rugose except gula and mentum; labrum finely punctate. Antennae with the apical segment constricted at the center; each segment only very slightly wider at the apex than the base; inserted between the eyes and the base of the mandibles. Eyes slightly emarginate, a smooth canthus in the emargination. Mandible thin, apex bifid and acute. Maxillary palpi with the apical segment broad, widest near the center.

Thorax: notum as long as wide, sides sinuate, widest at apex; surface rugose; disc with three foveae, two anterior and one posterior. Sternum smoother than the disc of the pronotum. Legs slender, claws toothed, tooth small, slender, very acute. Elytra with five costae; surface rugose.

Abdomen: with the apical sternite produced at center; surface finely rugose.

Pubescence: dorsally covered with very short, white, sparse hairs, center with moderately dense, short whitish hairs, longer and denser on the abdomen.

Color: black with orange markings. Antennae with the basal two and one-half segments all testaceous. Thorax orange. Abdomen black with the tip of the last sternite testaceous, all but narrow basal portion of the apical tergite testaceous.

Length: 6 mm.

Allotype: ♂, same data as holotype.

The male agrees with the female except that the posterior half of the first three segments of the antennae are testaceous, and the apical abdominal sternite is less produced.

Male genitalia.—(Pl. XII & XIII, fig. 48). Median lobe long and slender, apex acute, not expanded, base with dorsally recurved process, apex of process expanded, broad, sides dorsally divergent, base irregularly V-shaped, apex sinuate; sub-basal apodeme slender, apex acute. Paramere with basal plates dorsally projecting, large, base evenly curved in lateral view, apical lobes long and slender, lobes one-half the length of the paramere. Tegminite long and slender, apex expanded, acute. Ninth abdominal sternite a plate truncate both basally and apically, sides parallel, nearly contiguous dorsally, long, dorsally curved basal process. Ninth tergite long, slender, V-shaped, membranous at center. Eighth abdominal sternite with two lobes, acute at the apex, united at the base, base emarginate. Eighth tergite a simple apically arcuate plate, membranous at the center. Setae on the apex of the tegminite, eighth abdominal sternite and tergite.

Individual variation.—This species exhibits considerable variation, if it is really one species only. There is a distinct blue form which exhibits certain differences in the shape of the expanded area of the basal process of the median lobe of the male genitalia. In addition, the thorax of this blue form is often, but not always distinctly and sparsely punctate. The typical form is black, with the thorax orange and the surface of the thorax is finely rugose. Some specimens of the black form have the thoracic foveae dark or piceous, the area, however, is indefinite.

Length: 5-9 mm.

Biology.—Recorded from "burrows of elderberry," on *Sambucus,* on *Ceanothus,* and reared from *Pinus tuberculata.*

Distribution.—This species is confined to the west from British Columbia south through California and east to Idaho, Utah, Nevada and Arizona, with one recorded each from (no precise data) Texas and Lower California.

Specimens examined.—This is a very abundant species. I have examined several hundred specimens and I have on file detailed locality data from over two hundred and fifty specimens.

ASCLERA PUNCTICOLLIS (Say)

Oedemera puncticollis Say, Journ. Acad. Nat. Sc., Philad., 3: 273, 1823.—LeConte, Compl. Writ. T. Say, 2: 161, 1859.—Haldem., Journ. Acad. Nat. Sc., Philad., (2), 1: 96, 1948, (Asclera).—Horn, Proc. Calif. Acad. Sc., (2), 6: 406, 1896, (Asclera).

Type locality: Missouri.

This species is most readily identified by the dark, central thoracic spot, which, although variable in size, is always present. The median lobe of the male genitalia is short, stout, and has two apical hooks. In this respect, it is quite different from the other members of the genus.

Male.—Top Mt. Whiteface, June 27, 1941, (H. Dietrich), [CU].

Head: short, surface rugose, except gula and mentum. Antennae with the apical segment constricted at the center; inserted between the eyes and the base of the mandibles; each segmnt slightly broader apically. Eyes very

slightly emarginate. Mandibles thin, acute, apex of each bifid. Maxillary palpi with the apical segment large, trapezoidal, widest near the base.

Thorax: notum wider than long, widest near apex; disc impressed, with two anterior and one posterior foveae, and a central weak carina; surface rugose. Sternum weakly rugose, shallow punctate, punctures widely separated. Legs slender, claws toothed, tooth very short, but acute. Elytra five-costate, costae two and three united at the base; surface rugose.

Abdomen: apical sternite produced at the apex.

Pubescence: dorsally with very short, golden hairs, sparse; ventral surface with fine, moderate dense, rather long golden hairs.

Color: black with orange markings. Head, legs, elytra and abdomen black; antennae black with basal two segments testaceous. Thorax orange with a large black central spot.

Length: 9 mm.

Male genitalia—(Pl. XI, fig. 46). Median lobe short, with basal portion stout, tapering to an acute apex which has two stout, subapical ventral hooks; base with dorsally recurved process, apex of process expanded, lateral margins apically divergent; apex broadly and slightly emarginate; sub-basal apodeme broad, widest at apex. Paremere base with two lateral, dorsally projecting plates; apex with two lobes nearly one-half the length of the paramere, ventral median suture nearly to lobes so that two halves are united for only a very short distance at the center. Tegminite long, broad at center, apex acute. Ninth abdominal sternite with apex acute and lateral process extending anteriorly. Tergtie a narrow V-shaped plate. Eighth abdominal sternite two lobes broad at the base and united; acute at the apex. Tergite an apically arcuate plate, membranous at center and base. Setae present on the apex of the tegminite, and eighth abdominal sternite and tergite.

Female.—same data as the male.

The female agrees with the male except that the maxillary palpi are less angulate.

Length: 8 mm.

Individual variation.—The central thoracic dark spot is variable in size, in some cases occupying nearly the entire dorsal surface, while in others smaller, but always present and always definite. The shape of the apical segment of the maxillary palpi is variable. It is usually trapezoidal but at times the apex is arcuate or somewhat acutely triangular.

Length: 5-9 mm.

Biology.—Unknown.

Distribution.—This species has what is apparently a rather peculiar distribution. I have seen material from Maine, New Hampshire, New York, Pennsylvania, New Jersey, Virginia, Mississippi, Missouri, Illinois, Texas, Nebraska, and California. The California material appears to be identical with the other, so I am forced to conclude that this species either is widely distributed throughout North America, or introduced into Cali-

fornia. There is no reason to think that the habits of this species are any different than *A. ruficollis*, a very common species. If it has evasive habits, that would account for its apparent rarity. As mentioned above, the male genitalia are quite distinct from the other members of the genus, which leads me to the idea that perhaps this is an ancient member of the genus, that it is becoming extinct, and at present is distributed in limited areas over widely separated portions of the country. It will be noted that there are no records from the transition zone.

Specimens examined.—46: 7 ♂, 8 ♀, 31 sex undetermined.

MAINE: Mt. Katahdin, summit alt., 5,215 ft., August 19, 1902, (H. S. Barber): 1, [USNM].

NEW HAMPSHIRE: White Mts. Valleys 1, [ANSP (Horn)].

NEW YORK: Ithaca, May: 1, [Author]. Mt. Whiteface, summit, June 27, 1941, (H. Dietrich): 1 ♀, 2; Mt. MacIntyre, June 11, 1942, (H. Dietrich): 1 ♀; Mt. Marcy, summit, July 31, 1940, (H. Dietrich): 1 ♀; Mt. MacIntyre, August 2, 1940, (H. Dietrich): 1; *no further data:* June: 1 ♀, [CU]. Whiteface Mt. trail, July 8, 1914, summit: 1, [AMNH].

NEW JERSEY: Clementon, May 2, 1909: 1, [USNM]. Lahaway, April 1, 1916: 1, [AMNH].

PENNSYLVANIA: *No further data:* 1 ♂, [Author]. 1, [AMNH].

VIRGINIA: Read Run, Fairfax Co., March 26, 1925, (R. C. & E. M. Shannon): 2 ♂, [USNM]. *No further data:* 1, [ANSP (Horn)].

NORTH CAROLINA: Southern Pines, (S. W. Foster): 1 ♀, [CU].

TEXAS: *No further data:* 1, [ANSP (Horn)].

MISSISSIPPI: Camp Shelby, Feb. 23, 1944, (C. D. Michner): 1; *no further data:* (Chas. Palm): 1; [AMNH].

MICHIGAN: *No further data:* 1, [CNHM].

ILLINOIS: Glen Ellyn, June 5, 1904: 1, [CNHM].

MISSOURI: Willard, May 18, 1919: 1; Atherton, April 29, 1916: 2; Matyville, April 23, 1931: 1, [CNHM].

IOWA: *No further data:* 1 ♂, [RPM].

COLORADO: *No further data:* 1, [ANSP (Horn)].

CALIFORNIA: Hullville, May 6, 1917: 1; *no further data:* 3, [CNHM]. Yosemite, alt. 3,800-4,000 ft., May 28, 1928: 1; Coalinga, March 5, 1937, (M. A. Cazier): 4, [AMNH]. *No further data:* 1 ♀, [OSU]. Coalinga, Mar. 20, 1940, (W. F. Barr): 1, [Idaho].

MIDDLE STATES: *No further data:* 1 ♂, [MCZ LeC.)].

NEBRASKA ETC. & TEXAS: *No further data:* 1 ♂, [MCZ (LeC.)].

ONTARIO: Toronto, (R. L. Crew): 1 ♀, [CU].

NO DATA: July 27: 1 ♀, [Author]. 1 ♂, [USNM].

ASCLERA NIGRA LeConte

Asclera nigra LeConte, Ann. & Mag. Nat. Hist., (4th ser.), 4: 379, 1869.—Horn, Proc. Calif. Acad. Sc., (2), 6: 406, 1896.

This totally black Asclera is easily separated on color alone.

Holotype: ♀, Vancouver, [MCZ (LeC.) type no. 4806].

Head: short, coarse, moderately deeply punctate. Antennae with the apical segment slightly constricted beyond the center; each segment slender, somewhat wider towards the apex. Eyes oval, distinctly emarginate near the base of the antennae and the emargination with a smooth shiny canthus;

eyes protruding. Maxillary palpi with the apical segment broadly triangular, widest near the center.

Thorax: notum broader anteriorly; disc with three broad shallow impressions or foveae, two anterior and one posterior. Surface rugose. Sternum with a somewhat rugose surface. Legs slender, claws all toothed, tooth acute, short, about one-third the length of the claw. Elytra with four distinct costae; surface rugose.

Abdomen with the apical sternite blunt at the apex with a slight central projection.

Pubescence: entire body including legs and antennae covered with very short moderately dense, whitish pubescence.

Color: entirely black including appendages.

Length: 9 mm.

Male.—Blewett, Washington, May 27, 1929, (M. D. Leonard), [CU].

The male agrees with the type in all essential respects.

Length: 9 mm.

Male genitalia.—(Pl. XI, fig. 45). Median lobe very long and slender, broadly dilated before the apex, apex acute. Base with a dorsally recurved process which is broadly expanded apically, expanded area with parallel sides, apex truncate, base abruptly narrowing. Sub-basal apodeme long and very slender, apex acute. Paramere with large basal, dorsally projecting processes. Apical lobes slender, acute at apex. Lobes one-third the length of the paramere; base deeply emarginate. Tegminite long, slender, apex acute, only very slightly expanded at the center. Ninth abdominal sternite a broad plate with lateral margins dorsally projecting, but not contiguous, base truncate; apex narrowly, moderately emarginated, base with long dorsally curved process. Tergite very long and slender, apex slightly expanded and slightly emarginate. Eighth abdominal sternite two stout, apically convergent lobes basally united, base broadly emarginate; tergite a plate acute at the apex, membranous at the center and base. Seta present on the apex of the eighth sternite lobes and the apex of the tergite.

Individual variation.—None observed.

Length: 6-10 mm.

Biology.—Adults are collected on willow.

Distribution.—Known only from British Columbia, Washington, Oregon and Idaho.

Specimens examined.—49: 26 ♂, 7 ♀, 16 sex undetermined.

BRITISH COLUMBIA: Vancouver, *no further data:* 1 ♀, [MCZ (LeC.) type]. North Bend, (Hubbard & Schwarz): 2 ♂, [USNM].

WASHINGTON: Blewett, May 27, 1929, (M. D. Leonard): 1 ♂, [CU]. Olympic Hot Springs, June 12, 1933, (M. C. Lane): 1 ♂, [USNM]. *No further data:* 1 ♀ [MCZ (LeC.)]. 5, [ANSP (Horn)]. Bumping Lake, May 19, (F. H. Shirck): 1 ♀ [OSU].

OREGON: Corvallis, April 12, 1936, (G. Ferguson): 21; Milton, Lincoln Mts., July 14, 1938, (K. Gray, J. Schuh): 1; Vernonia, April 13, 1936, (K. Gray, J. Schuh): 1, [AMNH]. Wallowa Mts., Eagle Creek Canyon, July 4, 1932, (F. H. Shirch): 1 ♂, [OSU]. Ochocons, May 14 1941: 1 ♂, 1 ♀; Siskiyou Summit, Jackson Co., alt. 3,400

ft., July 5, 1946, (B. Malkin): 1 ♂, [Malkin]. Camas Valley, June 14, 1936: 2 ♂; McMinnville, April 11, 1936: 1 ♂; Oregon south of Kooskooskie, Wash., June 10, 1940: 1 ♂; Wallow Lake, June 12, 1940: 1 ♂; Ochoco, N. F., June 14, 1941: 1 ♂; Newbridge, May 23, 1931: 1 ♂, (*all* K. M. & D. M. Fender), [Fender]. Maupin, June 6, 1937, (K. M. & D. M. Fender): 4 ♂, [Mackenzie]. *No further data:* 1, [ANSP (Horn)]. 3, [USNM]. 1 ♂, [RPM].

IDAHO:. Mts., Moscow, July 25, 1920, (R. C. Shannon): 1, [USNM]. Pierce, May 23, 1929, alt. 3,200 ft., (W. E. Schull): 1 ♂; Moscow Mts., June 1, 1931, (Paul Rice): 1 ♀; Moscow Mts., July 1, 1932, (C. Wakeland): 6 ♂; Lewiston, April 23, 1946, alt. 550 ft., (J. Klahr): 1 ♀ [Idaho]. *No further data:* (C. V. Piper): 1 ♂, 1, [USNM].

NO DATA: 1 ♀, [MCZ (LeC.) marked *unicolor* Mels.].

ASCLERA DISCOLOR LeConte

Asclera discolor LeConte, Trans. Amer. Ent. Soc., 5: 70, 1874.—Horn, Proc. Calif. Acad. Sc., (2), 6: 405, 1896.

The yellow elytra gradually blending to black towards the apex is a positive means for identification of this species.

Holotype: ♂, California, *no further data*, [MCZ (LeC.) type no. 4805].

Head: short closely and deeply punctured except gula. Antennae with segments slightly widened apically; inserted between the eyes and the base of the mandibles. Mandibles thin, acute at the apex; both bifid apically. Maxillary palpi with the apical segment broadly triangular, widest near the middle.

Thorax: notum widest subapically; punctures small, shallow; surface with three broad shallow impressions, two laterally and one basally. Sternum sparsely and shallowly punctate. Legs slender, claws all acutely toothed, tooth approaching ½ the length of the claw. Elytra with four prominent costae; surface rugose.

Abdomen: the apical sternite evenly arcuate; surface rugose, finely punctate.

Pubescence: entire body, including legs and antennae clothed in moderately dense, short, golden pubescence.

Color: brownish, with piceous markings. Head black, clypeus and mentum testaceous. Antennae piceous. Thorax pale orange with black central spot; venter black. Legs with the femora basally piceous, apically yellow; tibiae basally yellow, shading to piceous at apex; tarsi piceous. Elytra brownish with apex shading to piceous. Abdomen with venter black.

Length: 7 mm.

Male genitalia.—(Pl. X, fig. 44). Median lobe long, slender, apex acute, base with dorsally recurved, apically expanded, trapezoidal, apically broadly emarginate, basally V-shaped, process which has parallel sides as broad as long. Sub-basal apodeme long, slender. Paramere basally with expanded dorso-lateral plates; apical lobes short, apex acute; lobes one-fifth the length of the paramere. Tegminite a short lobe, not heavily chitinized, not projecting much beyond the apex of the ninth sternite. Ninth abdominal

sternite a curved plate with lateral margins contiguous dorsally, apex and base truncate, long basal dorsally curved process. Tergite a broad V-shaped plate, base acute; apex arcuate. Eighth abdominal sternite two lobes. Tergite an arcuate plate membranous at center. Setae present on lobes of the eighth sternite and apex of the eighth tergite.

Allotype: ♀, same data as male.

The female agrees with the male except that the apical sternite of the abdomen is acute at the apex; apical segment of the antennae falsely ringed.

Length: 8 mm.

Individual variation.—Very little variation observed except in the area of piceous or black color at the apex of the elytra which may be considerably less than half, rarely more, and usually approximately one-half the total area of the elytra.

Biology.—Adults recorded on *Ceanothus cursatus*.

Distribution.—This species is known from Washington, Oregon, California and Nevada.

Specimens examined.—47: 11 ♂, 16 ♀, 20 sex undetermined.

OREGON: Riddle, Douglas Co., May 4, 1936, (G. Ferguson): 1 ♂, [AMNH]. Lake-of-the-woods, Klamath Co., alt. 5,300 ft., July 5, 1946, (B. Malkin): 1 ♂, [Malkin]. Durkee, June 17, 1941: 3 ♀; Bear Springs, May 26, 1940: 1 ♂, 3 ♀; Baker Creek, April 26, 1939: 1 ♀, (*all* K. M. & D. M. Fender), [Fender].

CALIFORNIA: Plumas Co., June 14, 1913: 1; Siskiyou Co., June 1, 1911: 9; Eldorado Co., June 2, 1906: 5; Tuolumne Co., May 16, 1914: 1; Humboldt Co., June 7, 1938: 1; Mariposa Co., June 2, 1914: 3, [CNHM]. Echo Lake, alt. 7,400 ft., Aug. 8, 1931, (E. O. Essig): 2 ♀; Towle, June 25, 1933, (M. A. Cazier): 1 ♀; G. Alpine Cr., Tahoe Co., July 3, 1915, (E. P. VanDuzee): 1 ♂, [AMNH]. Fresno Co., May 27, 1915: 2 ♂, 3 ♀, [Alab.]. *No further data:* 1 ♂, 1 ♀, [ANSP (Horn) type and allotype]. Near San Francisco, (S. Hubbard): 1, [MCZ]. Chester, June 12, 1941, (D. J. & J. N. Knull): 4 ♂, 2 ♀, [OSU]. Riverton, June 17, 1946, (A. T. McClay): 1 ♂, 2 ♀, [McClay].

NEVADA: Chester, June 12, 1941: 1 ♂, 1 ♀, [CU].

In addition, there are specimens in the Horn Collection (ANSP) from Washington and Nevada.

ASCLERA AURIPILIS VanDyke

Asclera auripilis VanDyke, Pan.-Pac. Ent., 22: 81, 1946.

The slaty color with conspicuous though fine golden yellow pile of the elytra distinguishes this recently described species from the others of the genus.

Holotype: ♂, Sequoia National Park, Calif., late May and June 1939 (E. C. VanDyke), [CAS, (type no. 5508)].

Male.—Sequoia Natl. Park, Calif., Alt. 2,000-5,000 ft., Potwisha, May 20, 1929, [CAS, (paratype)].

Head: short with coarse, dense punctures; gula and mentum smooth. Antennae with each segment slightly wider at apex. Eyes emarginate near base of antennae, with a smooth canthus within the emargination. Mandibles thin, acute, both deeply bifid at apex. Maxillary palpi with the apical segment broadly triangular, widest near the middle.

Thorax: notum as long as wide, widest near apex, sides sinuate, surface rugose. Sternum somewhat rugose. Legs slender, claws acutely toothed, tooth one-sixth the length of the claw. Elytra with four prominent costae.

Abdomen with the apical sternite acute at the apex.

Pubescence: entirely covered with dense, moderately long golden pile, that of the elytra longest.

Color: piceous with orange markings. Head black; antennae with the basal two and base of the third segments testaceous, remainder piceous. Thorax orange with central piceous cloudy area. Legs testaceous with some piceous shading. Elytra piceous with golden shading due to vestiture. Abdomen black.

Length: 7 mm.

Male genitalia.—(Pl. XII & XIII, fig. 49). Median lobe moderately long, slender, apex acute, not expanded, base with dorsally recurved process with apex expanded, V-shaped, apex emarginate, broad; sub-basal apodeme long and slender. Paramere with basal dorsally projecting processes. Apex with slender lobes acute at apex, lobes one-fifth entire length of paramere. Ventral median suture nearly to lobes. Tegminite long and slender, expanded at apex. Ninth abdominal sternite a plate truncate at base, emarginate at apex with sides curved dorsally, not contiguous dorsally. Ninth tergite long and slender, V-shaped with center membranous. Eighth abdominal sternite two blunt stout lobes united at base, base very slightly and broadly emarginate. Eighth tergite an apically arcuate plate, membranous at center. Setae at apex of tegminite, on lobes of eight sternite and apex of eighth tergite.

Female.—Sequoia National Park, alt. 2,000-5,000 ft., May 28, 1929, (A. T. McClay), [McClay].

The female agrees with the male.

Length: 7 mm.

Individual variation.—None of importance observed in this short series.

Length: 6-9 mm.

Biology.—Unknown.

Distribution.—Known only from the type locality.

Specimens examined.—12: 3 ♂, 4 ♀, 5 sex undetermined.

CALIFORNIA: Sequoia National Park, alt. 2,000-5,000 ft., May 20: 1 ♂, [CAS (paratype)]: 1 ♀, 2; May 17: 1 ♂; May 28: 2; May 29: 1 ♀, 1; June 13: 1 ♂; 1929, (A. T. McClay), [McClay]. Same data, May 12, 1936: 1 ♀, [McClay].

COPIDITA LeConte

Copidita LeConte, New Species Col., 1: 164, 1866.—LeConte & Horn, Classif. Col. N. Amer., ed. 2: 405, 1883.— Champ., Biol. Centr.-Amer., Col., IV, 2: 111, 1889.—Horn, Proc. Calif. Acad. Sc., (2), 4: 398, 1896.

Genotype: Probosca quadrimaculata Motschulsky. [Monobasic].

Of the several species assigned to this genus by Horn in 1896, only the genotype is here retained, the remainder being assigned to the genera *Eume-*

comera and *Oxacis*. This genus may be recognized by the prominent prolongation of the ligula, the large, elongate body, and the maxillary palpi which are longer than the head.

Generic diagnosis.—Head elongate, but not produced, about one and one-half times as long as wide at the eyes. Antennae eleven-segmented in both sexes. Mandibles both bifid at the apex. Maxillary palpi with the apical segment cultriform, widest at the base. Notum longer than broad. Anterior coxae large, globose, conical, separated by a sharp sternal keel. Legs slender, claws simple. Apical sternite of the abdomen produced and truncate in the male, evenly arcuate in the female.

Male genitalia.—The median lobe is long, stout, heavily chitinized. The apex is expanded and has a recurved dorsal, apical hook. The base of the median lobe has a long, dorsally curved process with a chitinized apodeme anterior to it. The paramere is bilobed at the apex, the base is greatly expanded forming two large dorsally projecting plates. The apex of the lobes are acute and dorsally projecting. The tegminite appear to be absent. The ninth abdominal segment has the tergite and sternite firmly united. The sternite consists of a stout rod the apex of which is greatly enlarged laterally and dorsally, the base is dorsally curved. The apex forms a dorso-lateral plate which is fused with the tergite, the latter being a simple expanded plate. The ventral apex of the sternite is in the form of two dorsally projecting hooks. The eighth sternite is in the form of two well developed lobes, the apex of each being rather acute, the base truncate and the two united basally by a small area of membrane. The eighth tergite is lightly chitinized, the lateral margins more so than the center.

Biology.—Unknown.

Distribution.—The genus Copidita as here considered contains only the one species, a description of which follows, and is confined to the western portion of the United States from Oregon to Texas.

COPIDITA QUADRIMACULATA (Motschulsky)

Probosca quadrimaculata Motschulsky, Etudes Ent., 1: 78 1853.—Mannh., Bull. Moscou, 26: 267, (3), 1853, (Nacerdes).—LeConte, New Spec. Col., 1: 165, 1866, (Copidita).—Horn, Proc. Calif. Acad. Sc., (2), 6: 399, 1896.

Type locality: Sitka.

This species may be distinguished from the other members of this family by the large size and the fuscous-testaceous color, as well as the morphological characters mentioned in the generic discussion.

Male.—Pescardo, California, July 16, 1926, [USNM].

Form elongate, narrow. Head elongate, not produced, about one and one-half times as long as wide at the eyes; moderately rugose except gula which is transversely striate and labium which is sparsely punctate. Each segment of the antennae is of equal width throughout. The terminal segment of the antennae is notched ventrally. The eyes are oval and protruding. Both mandibles are bifid at the apex. Apical segment of the maxillary palpi cultriform, widest at the base.

Thorax: notum longer than broad; moderately rugose, sides arcuate, widest at the apex. Sides of the pronotum smooth. Anterior coxae large, globose, conical, separated by a sharp sternal keel. Legs slender, claws simple. Elytra without costae, surface rugose.

Abdomen with the apical sternite produced, the process truncate.

Pubescence: entire insect covered with dense, moderately long white pubescence except posterior half on deflected sides of pronotum and gular region.

Color: testaceous with fuscous markings. Head testaceous except for an arched fuscous band dorsally between the eyes. Antennae testaceous. Thorax yellow except for two central spots, one basal and one apical, almost forming a band, and two lateral, central spots, darker than thorax. Legs yellow, knees black. Elytra and abdomen piceous except for the testaceous apical sternite of the abdomen.

Length: 16 mm.

Male genitalia.—(Pl. XII & XIII, fig. 50). Median lobe long, stout, heavily chitinized; base with a long curved process and a long basal apodeme; apex with a large, stout apical enlargement and dorsal recurved hook and two equally stout sub-basal hooks situated a distance basally about one-fifth the length of the median lobe. Paramere a stout lobe, base greatly expanded forming two lateral plates; apex deeply emarginate forming two lobes, lobes curved ventrally at the apex and acute. Tegminite unobserved. Ninth abdominal segment with the sternite and tergite firmly joined. The sternite consists of a long rod which is expanded apically forming a dorsolateral plate which if fused with a simple hood-like tergite, the latter being expanded apically, the apex evenly arcuate. Apex of sternite in the form of two stout hooks, emarginate between hooks, hooks projecting dorsally. Eighth abdominal sternite two well developed lobes somewhat balde-like at the apex and united basally by a narrow membranous area; base truncate. Eighth tergite a simple plate poorly chitinized, apex arcuate, slightly emarginate. Base deeply emarginate. Tergite laterally broadly united to the sternite by membrane. Setae present on the lobes of the eighth sternite and the apex of the ninth sternite.

Female.—Laguna Beach, California, June 24, 1916, [CU].

The female agrees with the male except that the apical sternite of the abdomen is evenly arcuate.

Individual variation.—Size and coloration are most variable in this species. The length varies from 8 to 20 mm. The spots on the head and thorax may be more or less extensive than that mentioned in the examples above. The thoracic spots may become emerged into a central band extending from the base to the apex of the thorax. They also may be nearly absent. The same is true with the spot on the head. The entire front and vertex may be dark, or the spot may be almost absent. The sculpture, vestiture and form are constant.

Biology.—Specimens of this species have been collected at light at night and diurnally on "sea beach."

Specimens examined.—88: 42 ♂, 26 ♀, 20 sex undetermined.

OREGON: Glenada, July 20, 1941: 1 ♀; Coos Head, Coos Co., Aug. 10, 1941: 1 ♂, [Malkin]. Pacific City, Sept. 10, 1938: 4 ♀, 2 ♂; Pacific City, July 23, 1942, (K. M. & D. M. Fender): 1 ♀; Woods, July 25, 1940, (K. M. & D. M. Fender): 1 ♀, [Fender]. Pacific City, July 21, 1942, (K. M. Fender): 4 ♂, [Mackenzie].
CALIFORNIA: Riverton, July 8, 1931, (E. C. Zimmerman): 1; Pescadero, July 16, 1926: 1 ♂; Moss Beach, Sept. 20, 1925: 1 ♂; Los Angeles Co., 1 ♂, [USNM]. Coronado Beach, July 25, 1927: 2 ♀; Laguna Beach, June 24, 1916: 1 ♀, [CU]. San Benito Co., Aug. 9, 1940, (D. J. & J. N. Knull): 1 ♂, [OSU]. San Francisco: 8; Long Springs, July 4, 1908: 1, [CNHM]. Indio: 1 ♀; Santa Cruz, July 30, 1901: 7 ♂, 1 ♀, [CU]. San Clemente, Oct. 2, 1946, (G. P. Mackenzie): 9 ♀, [Mackenzie]. San Francisco Co., Aug. 1908, (Wickham): 6 ♂, [Alab.]. Santa Cruz, July 23, 1939, (W. F. Barr): 1 ♀, [Idaho]. *No further data:* 7 ♂, 1 ♀, [MCZ (LeC.)]. 7, [AMNH]. 3, [CNHM]. 4 ♂, 1 ♀, [RPM].
ARIZONA: *No further data:* 3 ♂, [RPM].
TEXAS: *No further data:* 3 ♂, [USNM].
NO DATA: 5 ♀, [MCZ (LeC.)]. 2 ♂, [CU].

RHINOPLATIA Horn

Rhioplatia Horn, Trans. Amer. Ent. Soc., 2: 137, 1868.—LeConte & Horn, Class. of N. Amer. Col., ed. 2, p. 405, 1883.—Horn, Proc. Calif. Acad. Sc., (2), 6: 420, 1896.—Seidlitz, in Erichson, Naturgesch. Ins. Deutschl., V, 2: 815, 1899.—Arnett, Proc. Ent. Soc. Wash., 49: 241, 1947.

Genotype: Rhinoplatia ruficollis Horn, 1868. [Monobasic.]

This genus may be readily recognized by the greatly elongate head and thorax.

Generic diagnosis.—Head very elongate, at least three times as long as the width at the base of the antennae, not narrowed behind the eyes; last joint of the maxillary palpi narrowly triangular, widest near the middle; mandibles elongate, arcuate at tip and acute; labrum elongate, quadrate, angles only slightly protruding; antennae inserted midway between the eyes and the base of the mandibles, filiform, eleven-segmented in both sexes, female with the apical segment ringed at the center, giving the appearance of two segments.

Thorax elongate, one and one-half to two times as long as wide. Legs long, uniform; anterior tibiae with two apical spurs; penultimate joint of the tarsi alone spongy beneath, claws simple.

Elytra elongate, acute at the tip and covering the abdomen, pubescent and punctate, with at most very vague costae. Abdomen of five visible segments in both sexes, the terminal segment conical in the male, broader in the female.

Male genitalia.—Median lobe with a large apical ventrally projecting hook, and two dorsally projecting basal processes, the posterior one curved anteriorly and the anterior one semi-chitinous; paramere deeply bifid both basally and apically, with the basal plates large, forming two flaps which extend dorsally and surround both of the basal processes of the median lobe; apex of the ninth abdominal sternite armed with two teeth which are hook-like and bent towards the tergite; base of the sternite long, narrow and somewhat dorsally curved; tegminite a small, semi-chitinous, palpus-like lobe present on the inner surface

of the sternite; eighth abdominal segment with both the sternite and the tergite deeply bilobed and setigious.

Biology.—Nothing is known of the habits of the immature stages of these species. The adults are found on flowers.

Distribution.—The genus *Rhinoplatia* as here understood comprises two species for the world, both of which are confined to the western part of the United States.

KEY TO THE SPECIES

Thorax one and one-half times as long as wide; elytra uniform in color .....*ruficollis* Horn
Thorax twice as long as wide; elytra with the sub-apex darker than the remaining portion .....*mortivallicola* Arn.

KEY TO THE MALES

Median lobe with a small ventral hook located at approximately two-thirds the distance from the base .....*mortivallicola* Arn.
Median lobe with an apical, ventral hook only .....*ruficollis* Horn

RHINOPLATIA RUFICOLLIS Horn

Rhinoplatia ruficollis Horn, Trans. Amer. Ent. Soc., 2: 138, 1868.—Horn, Proc. Calif. Acad. Sc., (2), 6: 421, 1896.—Arnett, Proc. Ent. Soc. Wash., 49: 242, 1947.

The shorter, broader thorax and the uniform color of the pubescence of the elytra readily differentiates *R. ruficollis* from the following Death Valley form, *R. mortivallicola*. Other differences are explained in more detail under *R. mortivallicola*.

Holotype: ♀, Owen's Valley, California, [ANSP (Horn) lectotype no. 8071].

Head elongate, three times as long as wide at the base of the antennae, sparsely punctate; antennae filiform, inserted midway between the eyes and the base of the mandibles, eleven-segmented; eyes oval, not emarginate, not protruding; mandibles long, acute at the apex and not bifid; apical segment of the maxillary palpi triangular, widest near the middle.

Thorax about one and a half times as long as wide, sides sinuate, wider towards the head, sparsely punctate; legs narrow, penultimate segment bilobed and spongy beneath.

Elytra elongate, acute at the apex, sometimes with vague costae, densely punctate.

Entire insect clothed with moderately dense griseous pubescence; color bluish-black; the head black, thorax reddish-orange; legs and antennae piceous; elytra piceous.

Length: 8 mm.

Male.—Upper Soda Springs, Siskiyou Co., Calif., (J. E. Cottle), [Author].

The male agrees with the female in all essential respects.

Male genitalia.—(Pl. XIV, fig. 51). Small; the median lobe long, curved, with a large ventrally projecting apical hook, basally with a dorsally recurved process and a sub-basal apodeme which is semi-chitinous, dorsally projecting

and of the same length as the basal process; paramere deeply bifid both apically and basally, basal plates large and dorsally projecting; ninth abdominal sternite basally with a long, slightly dorsally curved process; apically armed with two outwardly curved, somewhat hooked, moderately long and thin teeth; tergite fused to sternite, moderately acute at the apex; tegminite attached interiorly to the ninth sternite and projecting beyond the apical edge of the sternite; eighth abdominal sternite and tergite both deeply bilobed. Setae present on the following: ninth segment: apical row on the dorsal plate, basal row before the basal process; apex of the lobe of the ventral plate; eighth segment: lobes of both the dorsal and the ventral plates.

Individual variation.—The apical half of the head is reddish-orange in some specimens. The elytra rarely have a purplish tinge.

Length: 5-12 mm.

Distribution.—The present species ranges from the western part of the Great Basin in Nevada and California southward into the Mojave and Colorado Deserts and thence westward into the Piedmont and Transverse Ranges (Los Angeles) district of southern California, with one record from the Virgin Mountains in the northwest corner of Arizona.

Specimens examined.—64: 36 ♂, 26 ♀, 2 sex undetermined.
CALIFORNIA: Upper Soda Springs, Siskiyou Co., (J. E. Cottle): 4 ♂, 5 ♀; [Author]. Coalinga, Fresno Co., below 500 ft. alt.: June 1-3, 1907, (J. C. Bradley): 1 ♀; [CU], May 14, 1938, (M. A. Cazier): 1 ♂; [AMNH]. Inyo Co., June 1, 1937: 1 ♂; [AMNH]. Westgard Pss Plateau, San Bernardino Co., (J. C. Cottle): 1 ♀; [Author]. Los Angeles Co.: 1 ♂; [CNHM]. Palm Springs, Riverside Co., May; (A. Fenyes): 5 ♂, 2 ♀; [CU]. Lancaster, Los Angeles: 1; [AMNH]. Alanche, San Bernardino Co., April-May 1917: 1 ♀; [CU]. Amboy, San Bernardino Co., May 3, 1941: (W. F. Barr): 1 ♀; Lone Pine, Inyo Co., June 1939. (L. R.Gillogly): 1 ♂; [Idaho]. Palm Springs, Riverside, May, (A. Fenyes): 4 ♂; [Alab.]. Cornic, June 29, 1933, (A. T. McClay), 1 ♂, [McClay]. Victorville, San Bernardino Co., May 20, 1939, (G. P. Mackenzie): 4 ♂, 3 ♀; Borrego: March 23, 1941, (G. P. Mackenzie): 1 ♂; [Mackenzie]. Baldwin Lake, San Bernardino Co., June 7, 1941: 2 ♂; Jacumba, San Diego Co., May 18, 1941: 1 ♂; Morongo Valley; May 28, 1941: 1 ♂; Mt. St. Helena, Sonoma Co., June 19, 1941: 1 ♀; Victorville, San Bernardino Co., June 6, 1941: 1 ♂, 2 ♀, 1; Lone Pine, Inyo Co., June 9, 1941: 1 ♀, (*all* D. J. & J. N. Knull), [OSU]. Los Angeles, Los Angeles Co.: 1 ♂, [USNM]. *No further data:* 2 ♂, 1 ♀; [MCZ (LeC.)].

ARIZONA: Virgin Mts., May 1, 1939, (W. P. Nye): 1 ♀, [USNM].
NEVADA: 25 mi. n. w. Gerlach, Washoe Co., May 29, 1939, (P. C. Ting, M. A. Cazier, J. A. Downes, T. Aitken): 2 ♀; [AMNH]. 25 mi. n. Wadsworth, Lyon Co., May 28, 1939, (P. C. Ting, M. A. Cazier, J. A. Downes, T. Aitken): 1 ♀; [AMNH]. Goldfield, Esmeralda Co.: 2 ♂; [CNHM]. Esmeralda Co.: 1 ♂ [CNHM].

RHINOPLATIA MORTIVALLICOLA Arnett

Rhinoplatia mortivallicola Arnett, Proc. Ent. Soc. Wash., 49: 243, 1947.

The longer, narrower thorax and the sparse, black pubescence at the subapex of the elytra readily differentiates this species from the preceding form, *R. ruficollis*. In addition, the head is entirely reddish-orange, while the preceding species has the head either all black, or black with the apical half reddish-orange. The thorax of *R. mortivallicola* is devoid of pubescence and is shiny,

while *R. ruficollis* has the thorax densely clothed with griseous pubescence. The male genitalia differ in that the ninth segment is armed with two short, hook-like teeth at the apex of the ventral plate; *R. ruficollis* has these teeth long, narrow and slightly curved laterally.

Holotype: ♂; Death Valley, California; March 28, 1932 [USNM, Cat. No. 58426].

Length: 14 mm.

Head elongate, three times as long as wide at the base of the antennae, sparsely punctate; antennae inserted midway between the eyes and the base of the mandibles; eyes oval, not emarginate, not protruding; mandibles long, acute at the tip and not bifid; apical segment of the maxillary palpi triangular, widest near the middle.

Thorax two times as long as wide, sides slightly sinuate, somewhat wider towards the head, sparsely and very obscurely punctate, and very shiny; legs narrow, penultimate segment bilobed and spongy beneath. Elytra elongate, acute at the apex, without vague costae, densely and closely punctate.

Entire insect clothed with moderately dense griseous pubescence except at the subapex of the elytra and the thorax; subapex of the elytra with sparse, black pubescence. Color bluish-black; the following reddish-orange: head, antennae, thorax, anterior coxae, and tarsi; blackish-orange; middle and hind coxae, all femora and tibiae.

Male genitalia.—(Pl. XIV, fig. 52). Large; the median lobe long, curved, with a ventrally projecting apical hook, a smaller subapical, ventrally projecting hook located at approximately two-thirds the distance from the base, basally with a dorsally recurved process and a slightly anterior semi-chitinous dorsal process of the same length; paramere with apical lobes long, basal pieces large and dorsally projecting; tegminite attached interiorly and not projecting beyond apical edge of ninth sternite; ninth abdominal segment with a long basal, ventral, slightly dorsally curved process, apex armed with two laterally bent, short, blunt, somewhat hooked teeth; tergite evenly rounded at the apex; eighth abdominal segment with both sternite and tergite deeply bilobed, tergite medianly membranous. Setae present on the following: ninth segment: apical row on the tergite; basal row before the basal process; tegminite: at apex; eighth segment: lobes of both the sternite and the tergite.

Allotype: ♀, same data as the type. [USNM].

Female.—Length: 12 mm. Agrees with the type in all essential respects except for the following: the apical segment of the antennae is falsely ringed giving the appearance of two segments.

Paratype: ♂; same data as the type. [USNM]. Length: 9 mm.

This specimen agrees with the type in all details except sixe.

Length: 9 mm.

Biology.—Unknown.

Distribution.—This species is known only from the type specimens all of which were collected in Death Valley, California.

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Appendix I

CHECKLIST OF THE NEARCTIC OEDEMERIDAE

Calopodinae

Calopus Fab.

1. Calopus angustus LeC. — B. C. to Calif., e. to Alberta, Ida., Colo. & N. M.

Sparedrus Latr.

2. Sparedrus aspersus (LeC.) — Tex., L. Calif.

Nacerdinae	
Xanthochroa Schmidt	
3. Xanthochroa trinotata LeC.	La. ♂: Alab.
4. Xanthochroa erythrocephala (Germ.)	N. Fla., to N. C. & w. to La. ♂:
syn. X. lateralis (Melsh.)	Kans.
syn. X. signaticollis Haldem.	
5. Xanthochroa testacea Horn	Van. Is., Wash., Ore., n. Calif.
6. Xanthochroa californica Horn	Calif.
7. Xanthochroa marina Horn	Calif., Ore.
8. Xanthochroa centralis Horn	Calif.
Nacerdes Dej.	
9. Nacerdes melanura (L.)	Atl. Coast, St. Lawr. Riv., Miss. Riv., Pacific Coast
Oedemerinae	
Ditylini	
Ditylus Fisch.—Waldh.	
10. Ditylus gracilis LeC.	Plumas Co., Calif. n. to Ketchikan, Alask.
syn. D. vestitus LeC.	
11. Ditylus quadricollis LeC.	Fresno Co., Calif., n. to Ketchikan, Alask., e. to Idaho
syn. Ditylus consors LeC.	
12. Ditylus caeruleus (Rand.)	Lake Sup. e. to Maine, s. to Adiron. Mts., N. Y., n. to Gravenhurst, Ont.
Asclerini	
Heliocis n. gen.	
13. Heliocis repanda (Horn)	D. C., Fla., Tex., Ariz., & Utah?
Eumecomera n. gen.	
14. Eumecomera bicolor (Horn)	Ore. & Calif.
15. Eumecomera cyanipennis (Horn)	Calif.
16. Eumecomera obscura (Horn)	Calif., N. M., Ariz., Tex., Nev., Utah & Colo.
Sisenes Champ.	
17. Sisenes championi Horn	Ariz.
Oxacis LeConte	
Subgenus *Oxacis* s. str.	
18. Oxacis laevicollis Horn	Calif., L. Calif., Ariz.
19. Oxacis fragilis Horn	Utah?, Ariz., Colo., Calif., & L. Calif.
20. Oxacis granulata LeC.	L. Calif.
21. Oxacis pallida (LeC.)	Utah s. to Tex., N. M., Ariz. & Calif.
syn. Oxacis sororia Horn	
syn. Oxacis grisea Horn	
22. Oxacis floridana Horn	Fla., Miss.
23. Oxacis taeniata (LeC.)	S. C. to Fla., Tex.?
24. Oxacis cana (LeC.)	Kty. & Mo. s. to Tex. & Ariz.
25. Oxaics dubiosa Horn	L. Calif.
26. Oxacis sericea Horn	Ore. & Idaho s. to Nev., Calif. & Tex.
27. Oxacis subfusca Horn	Ariz., N. M., Utah
28. Oxacis falli Blatch.	Fla.
Subgenus *Oxycopis* n. sub.	
29. Oxacis notoxoides (Fab.)	N. J. s. to Fla., w. to Tex. & Ark.
30. Oxacis thoracica (Fab.)	N. H. s. to Fla. & w. to Tex. & Ark.
syn. Oedemera fraxini Say	
31. Oxacis sutralis (Horn)	N. J. s. to Fla., Alab. & La.
32. Oxacis mimetica (Horn)	N. J. s. to Fla., w. to Iowa, Kans., Ark., & Tex.

33. Oxacis fuliginosa LeC.	L. Calif.
34. Oxacis mariea n. sp.	L. Calif., Ariz.
35. Oxacis dietrichi n. sp.	Miss.
36. Oxacis luteostriata n. sp.	Miami, Fla. s. to Palmetto Key
37. Oxacis mcdonaldi n. sp.	Fla.
Subgenus *Xanthochroina* Ganglb.	
38. Oxacis bicolor (LeC.)	Rocky Mts. to Calif.
Subgenus *Paroxacis* n. subg.	
39. Oxacis lucana (Lec.)	L. Calif., Mex. & Ariz.
40. Oxacis debilis Horn	Calif., L. Calif., Ariz.
41. Oxacis interrita n. sp.	La., Fla.
42. Oxacis recendita n. sp.	Tex., La., & Alab.
Alloxacis Horn	
43. Alloxacis dorsalis (Mels.) *syn. Xanthochroa vittata* Hald.	L. I., N. Y. s. to Fla., w. to Tex., s. to Mex.
44. Alloxacis pleuralis (LeC.)	Vir. s. to Fla., w. to Tex., L. Calif. & Mex.
45. Alloxacis floridana Horn	Fla.
46. Alloxacis nitidula Horn	Calif. & L. Calif.
47. Alloxacis pseudosericea n. sp.	Fla.
48. Alloxacis megateles n. sp.	Fla. & Fla. Keys
49. Alloxacis nesiotes n. sp.	Fla. Keys & Bahamas
50. Alloxacis ignota n. sp.	Fla. & Ga.
Asclera Steph.	
51. Asclera discolor LeC.	Wash., Ore., Calif., & Nev.
52. Asclera nigra LeC.	B. C., Wash., Ore., Idaho
53. Asclera puncticollis (Say)	Maine to Calif., s. to Vir., Miss., Tex.
54. Asclera ruficollis (Say) *syn. Oedemera carinata* Newn.	Que. s. to Alab., Tex.? & w. to Ind. Neb.?
55. Asclera excavata LeC.	W. Coast, e. to Idaho, Nev., Utah, Ariz. & Tex.?, L. Calif.?
56. Asclera auripilis VanDyke	Sequoia Natl. Park, Calif.
? Lagria rufifrons Fab.	
? Oedemera vestita Say	
Copidita LeC.	
57. Copidita quadrimaculata (Mots.)	Ore., Calif., Ariz., & Tex.
Rhinoplatia Horn	
58. Rhinoplatia ruficollis Horn	Calif., Nev.
59. Rhinoplatia mortivallicola Arnett	Death Valley, Calif.

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EXPLANATION OF PLATES

PLATE I. Figs. 1-5.—1. *Asclera ruficollis* (Say), Oedemeridae; right hind wing, dorsal view. 2. Diagrammatic structure of the terminal abdominal segments and the genitalia of a beetle, (sagittal section), [after Jeannel & Paulian, 1944]. Tg.—tegmen; m.l.—median lobe; g.o.—genital opening. 3. *Cephaloon lepturides* Newn., Cephaloidae; ♂ genitalia. a. median lobe; b. paramere; c. basal piece; t. 9th tergite; [all dorsal view]; s. 9th sternite, ventral view. 4. *Scraptia sericea* Mels., Melandryidae; ♂ genitalia. a. median lobe, dorsal view; L. lateral view of median lobe; tg. tegminite, dorsal view; p. paramere, dorsal view; b. lateral view of 9th segment; d. dorsal view of 9th segment; t. 8th tergite, dorsal view; s. 8th sternite, ventral view. 5. *Oedemera nobilis* L., Oedemeridae; ♂ genitalia. a. 8th tergite, dorsal view; b. 8th sternite, ventral view; c. 9th tergite, dorsal view; d. 9th sternite, ventral view; e. tegminite, dorsal view; f. paramere, lateral view; g. median lobe, dorsal-lateral view.

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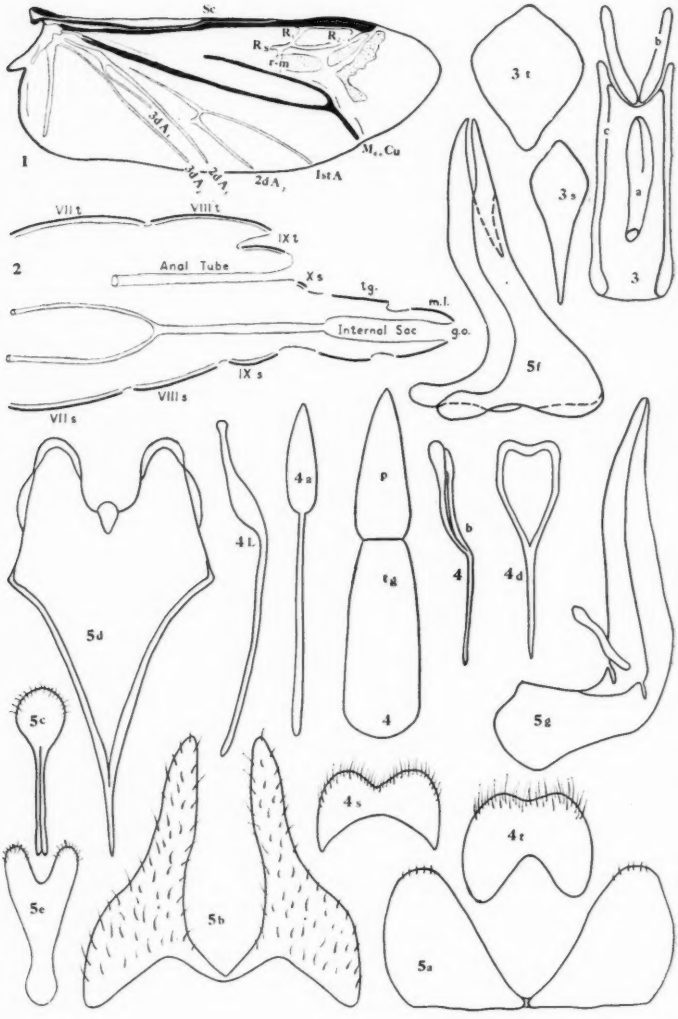
PLATE I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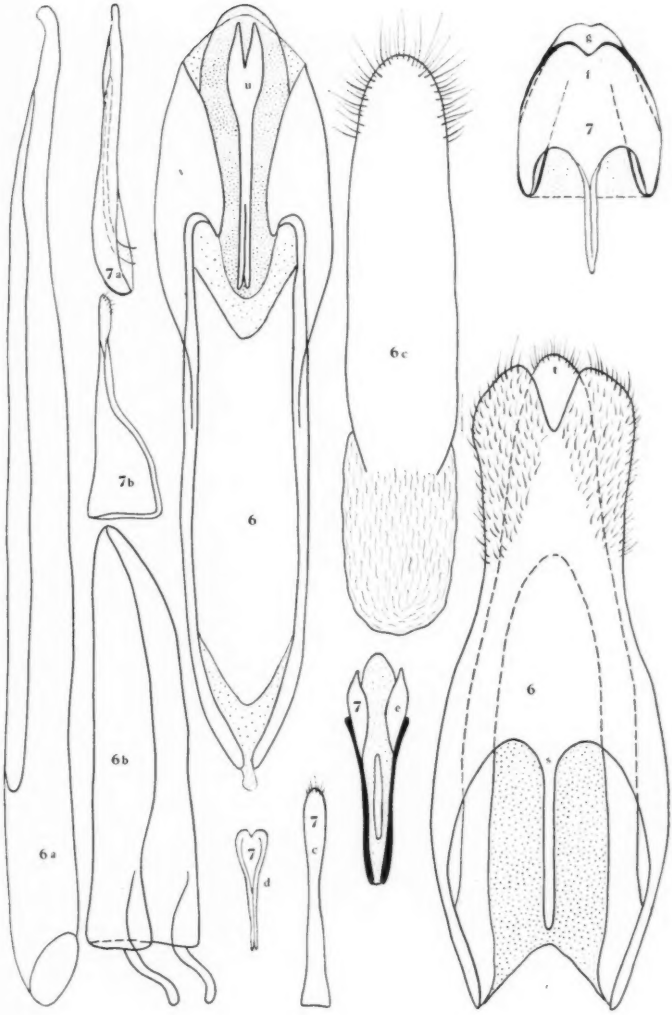

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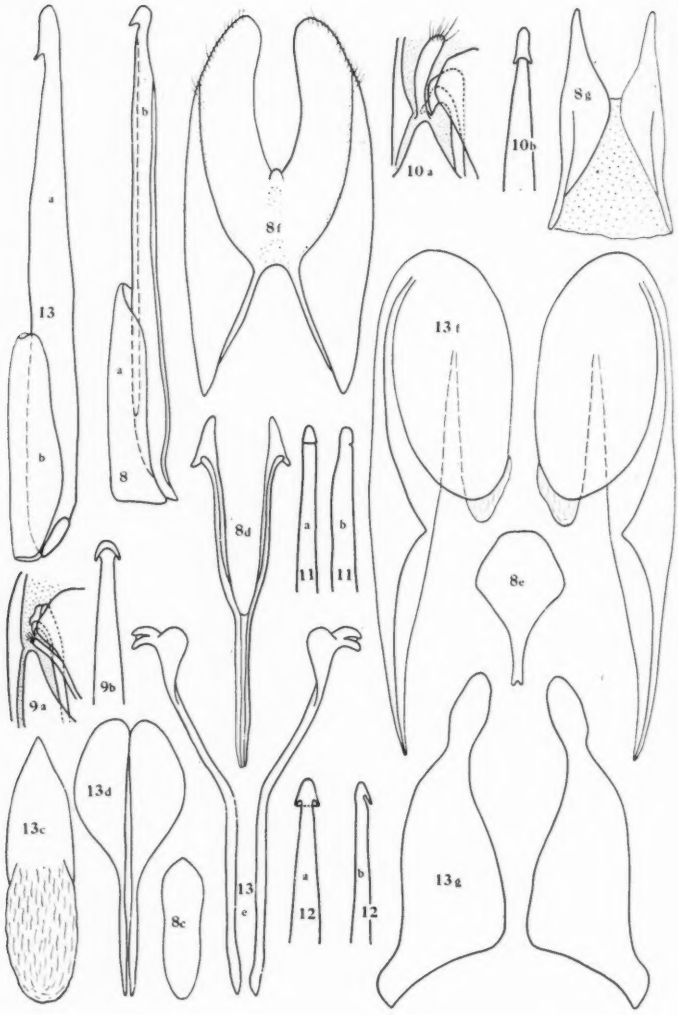
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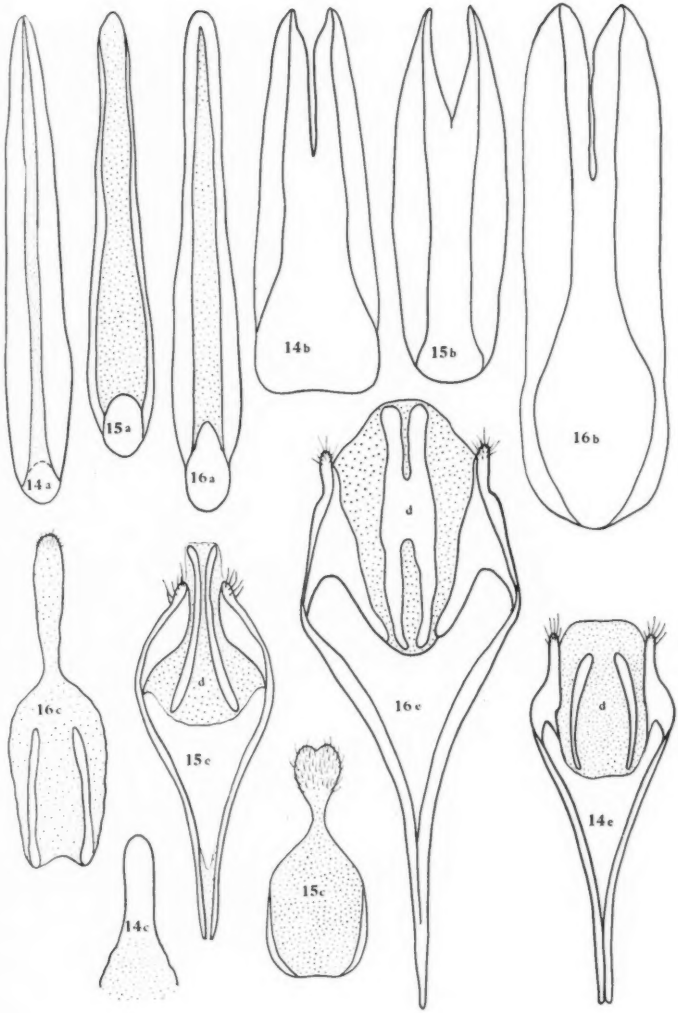

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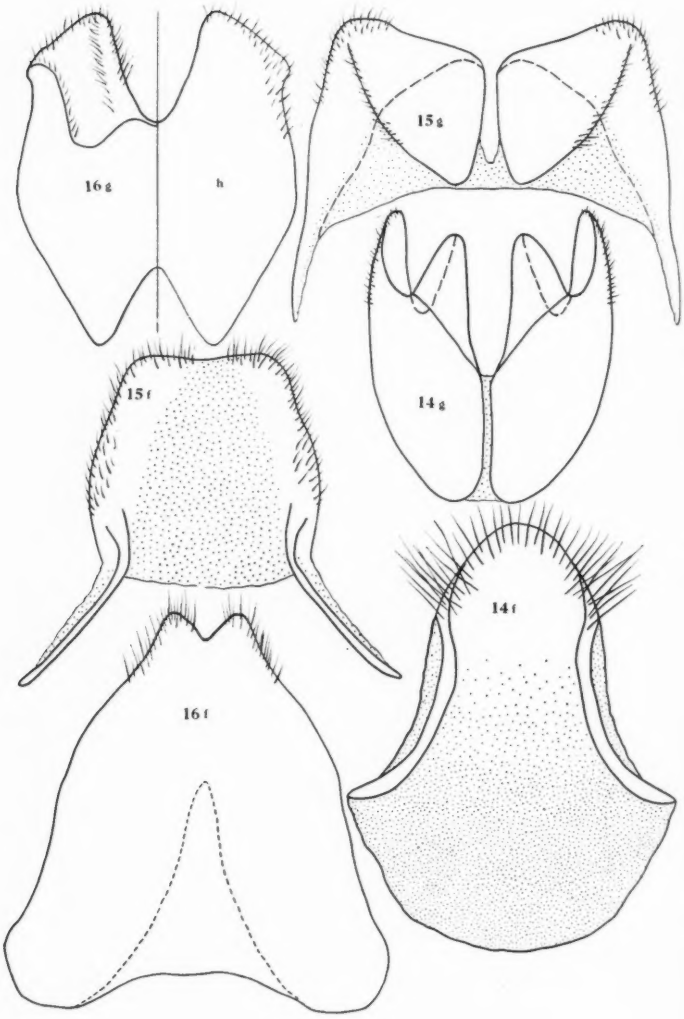

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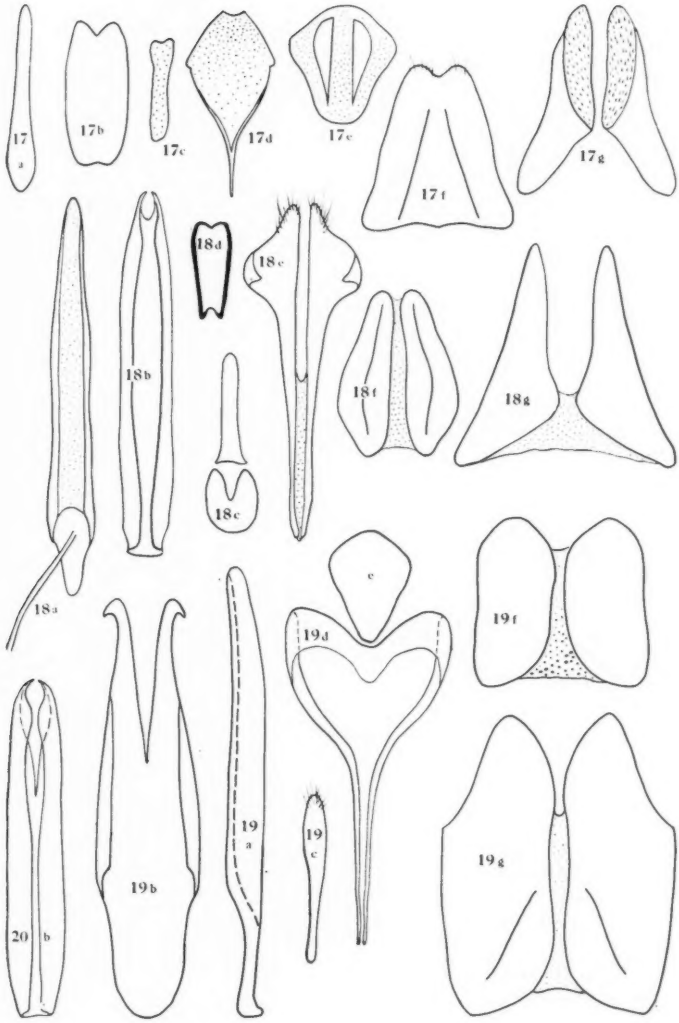
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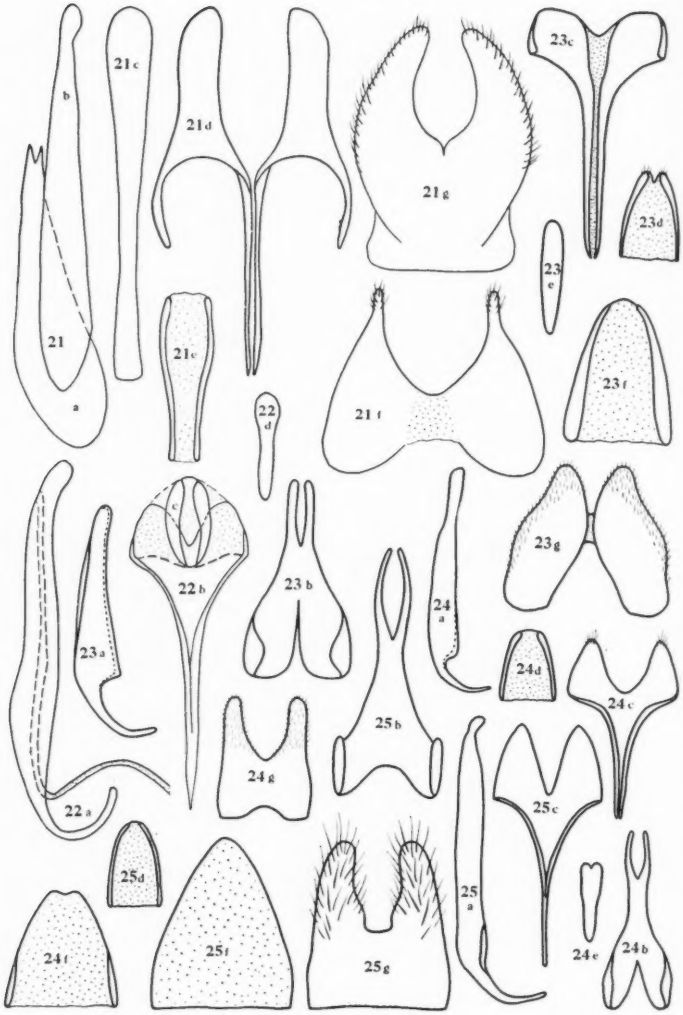
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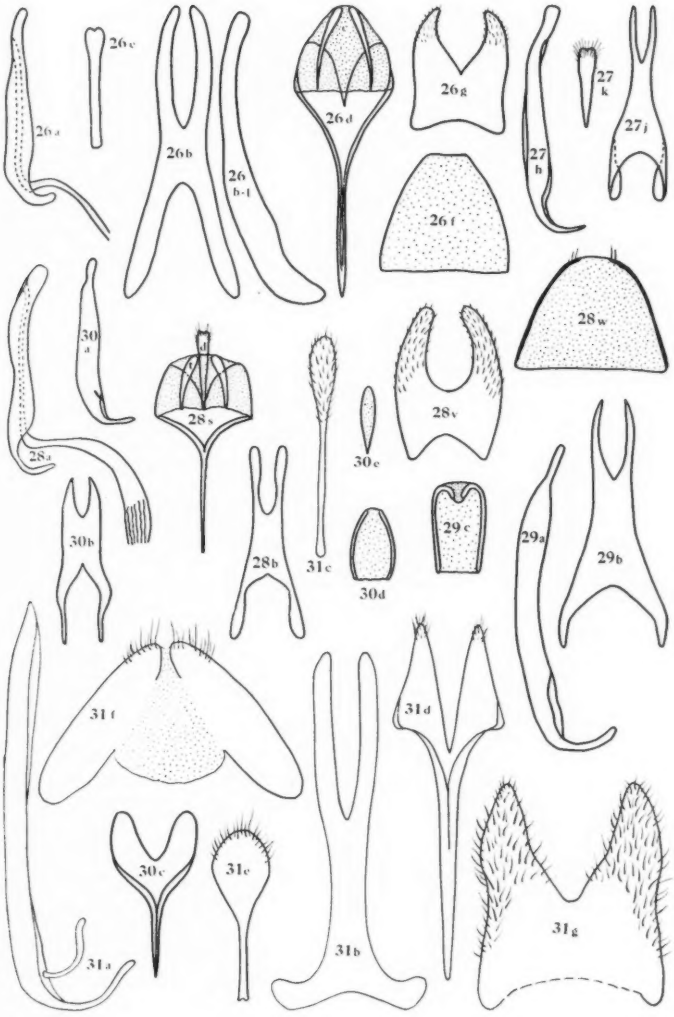
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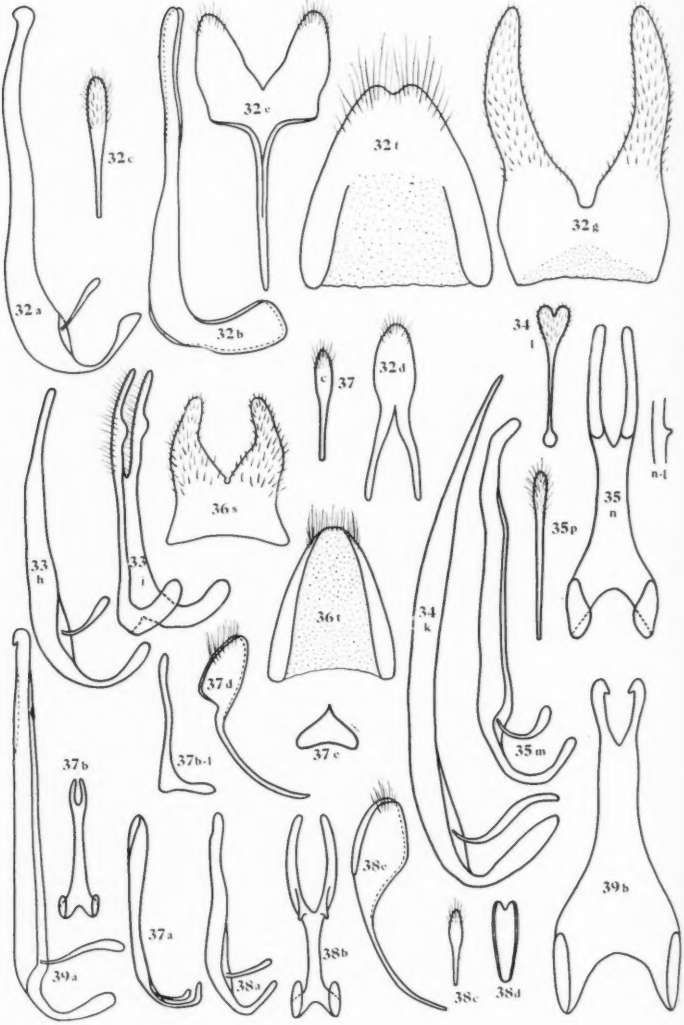
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PLATE X

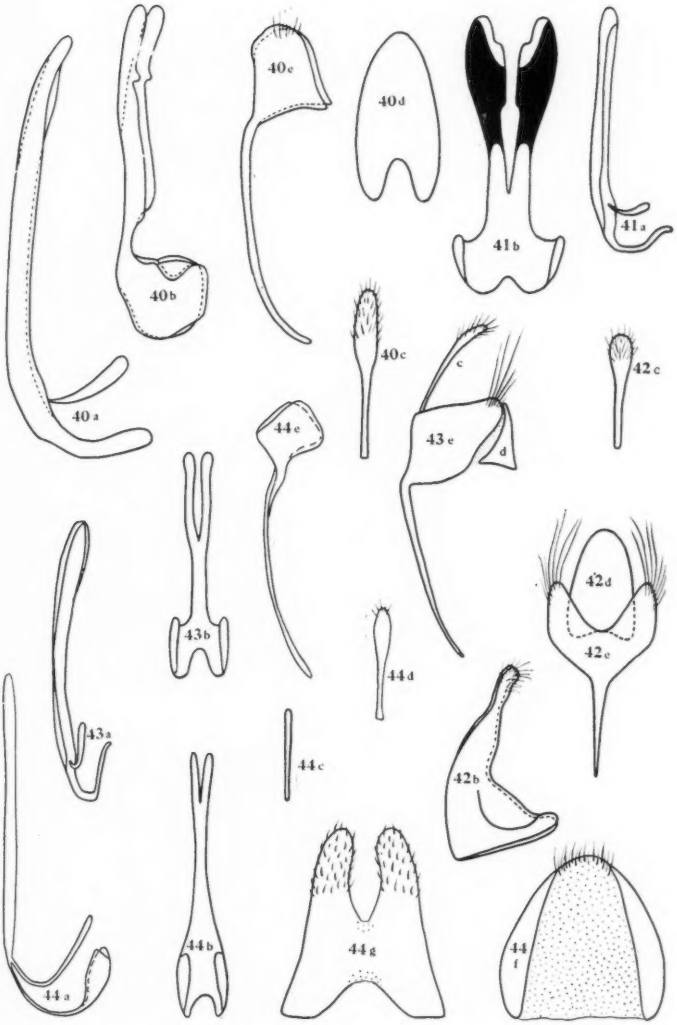
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PLATE XI

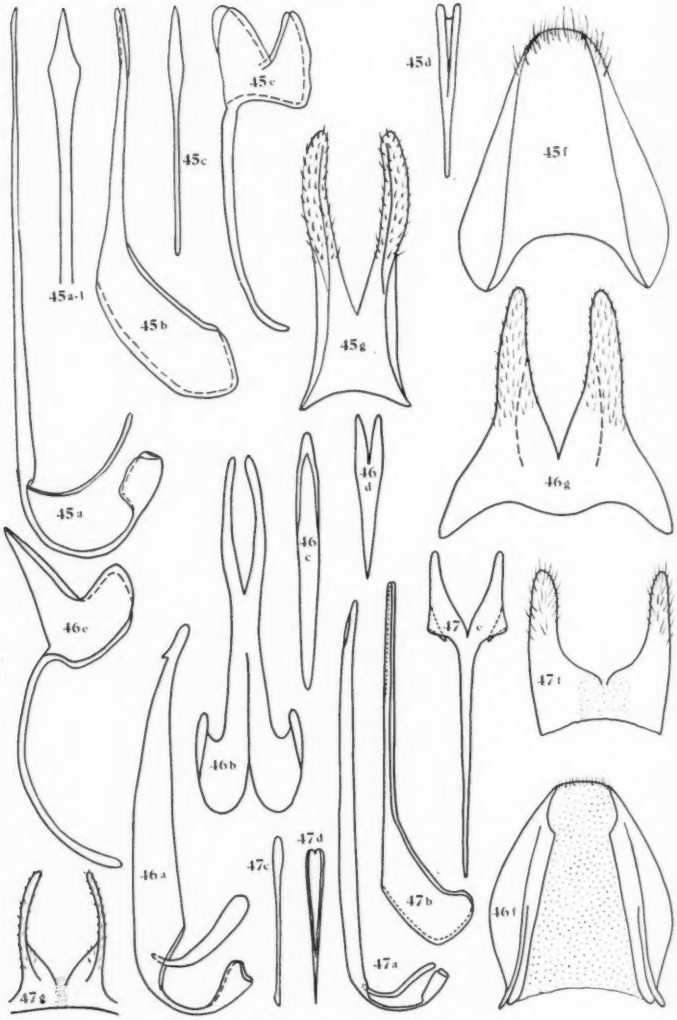
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PLATE XII

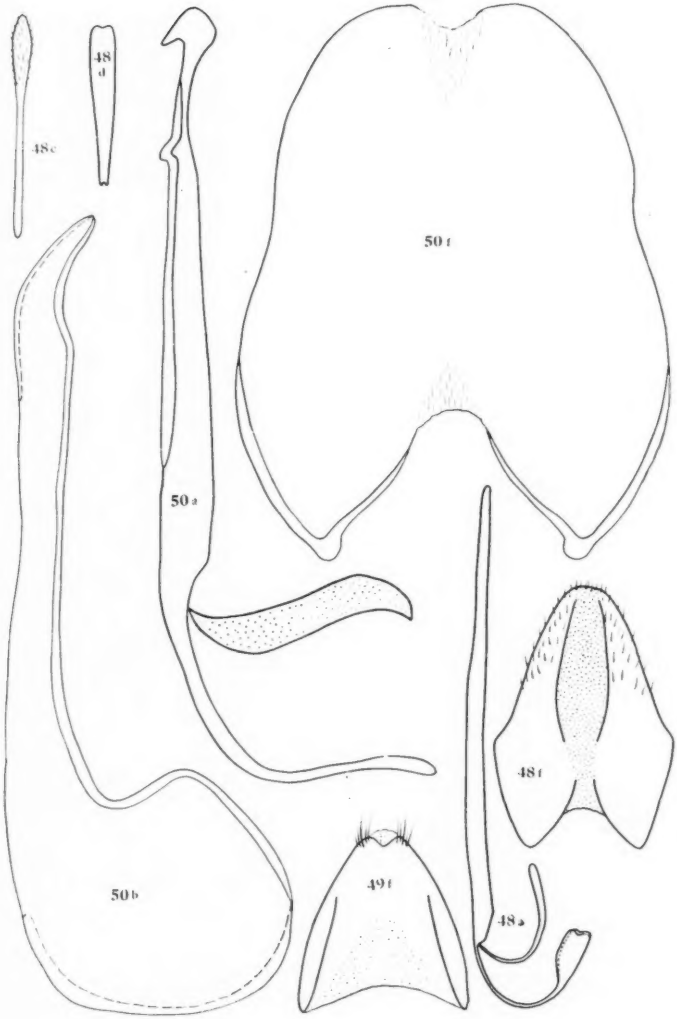


PLATE XIII

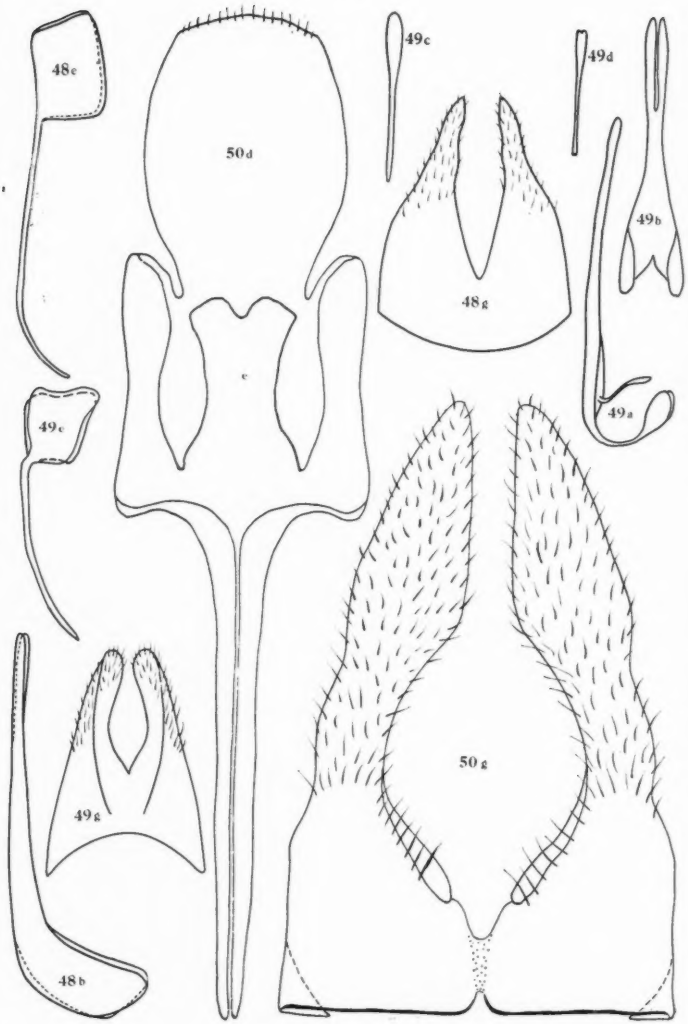
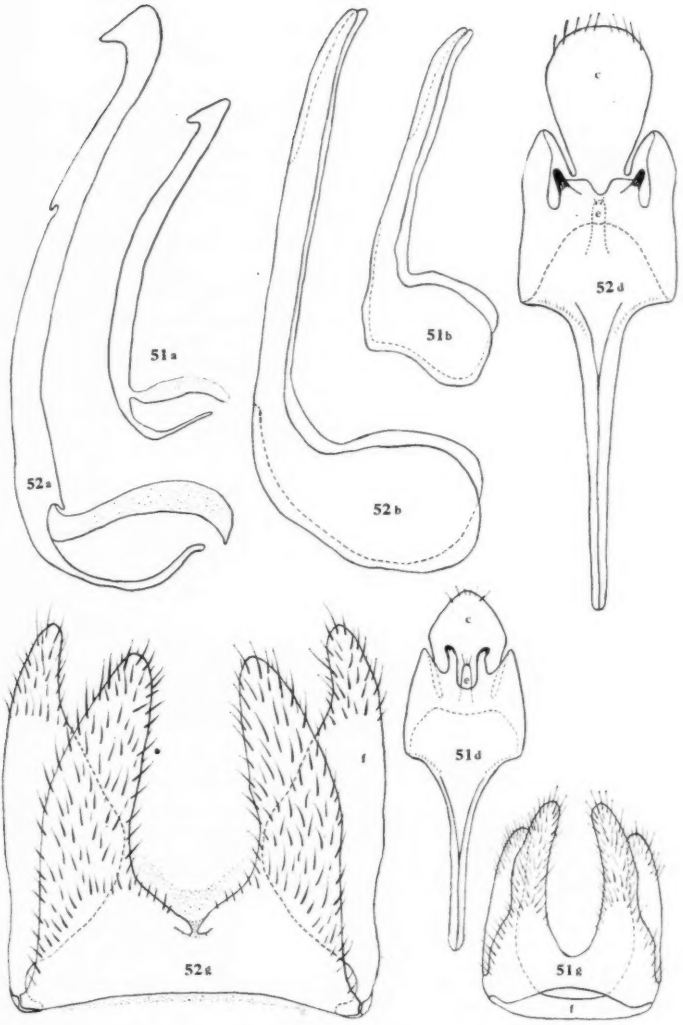


PLATE XIV



Nevada Dytiscidae (Coleoptera)[1]

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Extensive collecting during the past decade has indicated that Nevada, without doubt the most arid of the 48 states, has a comparatively large and varied aquatic coleopterous fauna. Of the total state area of 70,841,600 acres (= 110,690 square miles), only 556,160 acres (= 869 square miles) were listed as water surface by the Nevada Surveyor-General's office in 1913. Disregarding the inaccuracies of these figures,[2] they are, by virtue of climatic vicissitudes, merely approximations since many lake surfaces entirely disappear in dry years, most of the major rivers are subject to torrential flows of short duration, and may even dry up in the lower portions of their courses during late summer, and a great many smaller streams are entirely annual, appearing in late winter — early spring, and drying completely during summer and fall. In addition, deflection of flow for irrigation projects has aided in eliminating some water surfaces then (1913) in existence, such as the recently dried Winnemucca lake which only a few years ago was a body of water nearly 30 miles long. This represents a loss of approximately 15% of the state water surface.[2]

However, the above figures suffice to point out the small proportion of water-to-land surface in the state, although in the matter of lakes, Nevada appears more favored than such neighboring states as Arizona, which have no natural standing water bodies comparable to Pyramid and Walker Lakes.

The small water surface in Nevada can be attributed to the low general precipitation of the region, brought about largely by the idiosyncracies of Great Basin topography. The immediate restrictive consequences of the westerly Sierra Nevada range are forcefully reflected in the pronounced rainshadow effects along the eastern face of the range. These are strong enough to be felt for a considerable distance eastward, and are primarily responsible for producing a distinctive biologic route, which I have called the *Sonoran Trailway*,

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1 This study was aided in part by a research grant from the University of Nevada.

2 Modern planimetric checks of base maps indicate that at least certain of the water surface quotations listed by the Nevada Surveyor-General are widely in error. Lake surfaces such as Pyramid seem to have been grossly estimated by simply multiplying length by average width, a precarious procedure in light of the extremely tortuous shoreline. For example, Pyramid Lake, generally considered some 35 miles long by 10 miles wide, is listed with a surface area of 360 square miles. A planimeter reading from Russell's 1885 map, still the most authoritative report on the lake, both cartographically and descriptive, gave a surface area of some 216 square miles; actually, the lake is nearer 30 miles in length, and much less than ten in width. Similarly, Winnemucca Lake was listed as a water surface of 180 square miles, but planimetrically gave only half that figure at its high-water mark. These corrections reduce the previously reported water surface by over 25%, leaving the total water surface figure for the state at some 638 square miles. A planimetric reading of Walker Lake would doubtless reduce this figure still further.

from southern California and northwestern Arizona northward through western Nevada. Many Sonoran animals, vertebrate and invertebrate, have achieved considerable northward extensions of their ranges by living within the confines of this rainshadow trailway; a partial list of them has been given elsewhere (La Rivers 1948).

Such large lakes as Nevada does possess can be ascribed in great part to the graben-and-horst structure of the terrain, which produces a multitude of basins with no external drainage. These drainage systems vary in size from a single valley, often a small one, to such vast areas as the 45,000 square miles which comprised the drainage system of Pleistocene Lake Lahontan (a drainage system still intact). Few of these valleys and valley systems have any communication beyond the Great Basin.. These geomorphologic peculiarities have made possible the retention of the region's limited water supply in catchment basins, and the more voluminous and perennial streams have been able to provide enough flow to offset high evaporation rates and the depleting action of low watertables to produce lakes in certain suitably situated basins.

The paucity of water in the state is hardly important as a factor in the qualitative nature of the aquatic coleopterous fauna, since a shallow pond usually contains a greater variety of species than does a large lake, but certainly it has a direct influence on the quantitative aspects of the fauna. Certain water conditions peculiar to land-locked basins also operate further to restrict faunae, both qualitatively and quantitatively. By water loss through constant evaporation, some of the standing water bodies have become too saline or alkaline to support any but the small number of halophiles adapted to such situations — in the case of Coleoptera (where only mildly brackish waters are involved), this restriction is probably due more to the difficulty of obtaining food in such situations, since plant growths are much restricted, than to intolerance for the solutes themselves. Permanent lakes in Nevada exhibit all gradations from fresh-to-brackish, and many of the annual water surfaces, such as playas, are totally saturated with salines or alkalines. Littoral plant growth is markedly restricted in even the mildly brackish waters, and totally absent in most saturated waters. As a result, a significant portion of Nevada's standing water supply is unavailable to aquatic Coleoptera. Hot springs, of which the state has many, while providing special thermal habitats for certain species, also supply low-temperature waters for the general aquatic fauna since they are the sources of many cool ponds about them. They are also of significance in that their waters contain above-average amounts of total solids.

Various changes in the environics of water surfaces themselves may operate to further restrict populations of aquatic insects. For example, ponds densely covered with algal growths nearly always have only "half rations" of insects, whereas clear-surfaced ponds usually teem with insects.

Because of the fact that the vast majority of aquatic Coleoptera are winged, and fly readily, such intense endemism as that claimed for many of our native fishes by reason of the long isolation of Nevada's few drainage systems from each other and from the exterior, has been scarcely apparent among these

insects. Only a minute fragment of the total aquatic coleopterous population is known to be composed of these endemics, and they have usually been described from thermal waters. Operating further to restrict the variant potential of individual, isolated populations is the fact that a great many of these water bodies are extremely small, so that the population of any one species capable of being supported by such pools has a correspondingly lowered genetic diversity potential.

Too little is known of aquatic biologies to state whether any of the species involved are adapted to desert conditions in that they possess a stage (usually the egg) capable of surviving total desiccation of their water medium as do the phyllopods. The distribution potential of winged aquatics is quite high, and a spring appearing in a given locality for the first time (as occasionally happens in mining activities), even though several miles from the nearest water, within a single season will usually acquire a sizable population of flight-dispersed aquatics. Thus, except for the fact that aridity operates to restrict water areas, and may render others unavailable due to excessive evaporative conditions, it is of little or no significance as an environmental factor where fresh waters are concerned. A desert is such by virtue of its comparative lack of moisture, but where water is available in arid regions, the resulting aquatic insect populations will not differ sensibly from the same populations in more humid, non-desert area. Such endemics as are found, in this case, are all, to my knowledge, referrable to factors such as temperature, percentage and type of solutes, etc.; and these are by no means restricted to the waters of arid regions, but may be found regardless of the prevalent humidity.

ECONOMICS

The position of aquatic insects, usually the dominant element in their environment, in the foodchains of such situations needs hardly to be emphasized here. Not only do they form a large part of the food of most fishes, but in turn are often important predators of the young of large fishes and the adults of small fishes. The chief concern involving insects as fish predators is mainly expressed by those interested in game fishes. Here fry are reared under artificial conditions which enable certain insects to dominate the environment to a greater extent than seems possible under natural conditions. In natural environments, it is not uncommon for certain fishes to increase to such an extent that the insect population becomes markedly depleted, but the alternate situation, where insects operate to decrease the fish fauna, has not been observed in Nevada although there are here many places where insects would theoretically have a position of control due to the small size of the water body and the over-abundance of the native fish population.

Aquatic insects are also important, in certain instances, as the only contributing source of animal organic material to the bottoms of small pools and seeps, which undoubtedly exerts some effect upon the vigor of plant growth there; and even in the presence of a well-balanced fauna of other invertebrates and vertebrates, the organic matter originating from the insect population is an important item.

ACKNOWLEDGEMENT

I would like to take this opportunity to express my great appreciation to Mr. Hugh B. Leech of the California Academy of Sciences for determining most of my aquatic Coleoptera, and for looking over an early draft of the manuscript. To Mr. Harry P. Chandler of the California Division of Fish and Game, I am indebted for certain determinations and advice. The below-mentioned colleagues have collected with me extensively over the State, and to them I owe many specimens: Thomas J. Trelease of the Nevada Fish and Game Commission, and Glen C. Christensen and Benjamin H. Banta of Reno.

NEVADA DYTISCIDAE

KEY TO GENERA—ADULTS

1. Scutellum fully covered, or rarely with a small tip visible 2
——— Scutellum entirely free 7

2(1). Prosternal base in same plane as its process; fore- and mid-tarsi distinctly 5-segmented, 4th segment approximately as long as 3rd ..... *Laccophilus*
——— Prosternal base not on a plane with its process, which is strongly bent downward; fore- and mid-tarsi usually pseudotetramerous (i.e., 4th segment minute and usually hidden between lobes of 3rd) 3

3(2). Trochanter base free; coxal process short, flat, almost in a plane with sternites, and without lateral wings ..... *Bidessus*
——— Trochanter base covered by hind coxal process, which is not on a level with first sternite, but somewhat raised, its sides divergent, more-or-less produced into lobes or lateral wings 4

4(3). Elytral epipleura with a basal excavation which receives the middle knee; epipleura appearing obliquely truncate, with an oblique carina at base ..... (Coelambus) *Hygrotus*
——— Elytral epipleura not excavated and lacking oblique basal carina 5

5(4). Mesial line between hindcoxal processes not abbreviated behind, the apex either truncate or angularly prominent at middle ..... *Hydroporus*
——— Mesial line more-or-less abbreviated behind, the lateral lobes more produced posteriorly 6

6(5). Body beneath excessively densely micro-punctulate but without scattered larger punctures; hindthighs densely punctate over their entire surface; pronotum without sublateral impressed line or fovea ..... *Derovatus*
——— Body beneath more-or-less punctate; hindthighs with a median line of setigerous punctures, otherwise sparsely punctate or nearly smooth; pronotum with sublateral longitudinal impressed line or fovea ..... *Oreodytes*

7(1). Eyes emarginate above antennal bases; first three segments of male tarsi widened, but not forming a round adhesion disc 8
——— Eyes not emarginate; first three segments of male tarsi forming a round or oval adhesion disc 12

8(7). Hindfemora with a linear group of cilia near the posterior apical angles; pleurites of 2nd abdominal segment (beneath elytra) not strongly sclerotized, without transverse rugae 9
——— Hindfemora without linear group of cilia; pleurites of 2nd abdominal segment strongly sclerotized, with transverse rugae 10

9(8). Hindtarsal claws obviously unequal, outer one of each pair two-thirds or less the length of inner claw ..... *Ilybius*
——— Hindtarsal claws of equal length; if slightly unequal, then both are very short, only one-third length of fifth tarsal segment ..... *Agabus*

10(8). Side lobes of metasternum narrow, linear ..... *Coptotomus*

———Metasternal side lobes broad, wedge-shaped 11

11(10). Metasternum with a broad and distinct pit-like depression on anterior border between coxae; pronotum usually margined ..... *Rhantus*

———Metasternum flat between coxae, or with a small indistinct longitudinal impression; pronotum not margined ..... *Colymbetes*

12(7). Hind margin of first four segments of posterior tarsus beset for entire length with a coarse fringe of golden yellow, flat cilia 13

———Hind margin of same without such a fringe, or only with cilia on outer apical angle 14

13(12). Venter, elytra and pronotum coarsely punctate; adhesion discs of male tarsi with a large basal, and two small median, sucking cups, in front of which is a thick transverse brush of stout bristles, each of which bears on its tip a rounded adhesive plate (females often with canaliculate elytra) ..... *Acilius*

———Body almost smooth, with scarcely observable micropunctulation; male adhesion disc with a few large and many smaller suction cups ..... *Thermonectus*

14(12). Hindtibia distinctly longer than broad, its outer apical spur slender, not broader than the inner; adhesion discs of male round, with two large basal cups in front of which are numerous small discs ..... *Dytiscus*

———Hindtibia almost as broad as long, its outer apical spur basally strongly expanded; male adhesion discs transversely oval, with 3-4 transverse rows of petiolate adhesive plates, behind which is a fringe of bristles ..... *Cybister*

LARVAE

1. Head with a frontal projection; body lacking lateral fringes of swimming hairs; maxillary palpus 3-segmented 2

———Head without a frontal projection; body with or without swimming hairs; maxillary palpus 4-segmented or more 5

2(1). Frontal projection with a notch at each side 3

———Frontal projection without such notches 4

3(2). Cerci with only primary hairs, 6-7 in number ..... *Hydroporus*—*Hygrotus*

———Cerci with additional secondary hairs ..... *Oreodytes* (in part)—*Deronectes*

4(2). Larva not markedly widened in middle; last abdominal segment long and tapering; cerci with only primary hairs ..... *Bidessus*

———Larva greatly widened in middle; last abdominal segment long or short; cerci only with secondary hairs or none ..... (in part) *Oreodytes*

5(1). Maxillary stipes broad, suboval, with 1-2 strong inner marginal hooks 6

———Maxillary stipes slender, long, with no inner marginal hooks 13

6(5). Abdominal segments 7-8 laterally lacking series of swimming hairs; ligula absent 7

———Abdominal segments 7-8 with swimming hairs; ligula present 11

7(6). Temporal spines long, 2-5 in number ..... *Laccophilus*

———Temporal spines short, numerous, occasionally short-and-long mixed 8

8(7). Antennae with short apical segment 9

———Antennal apical segment as long as penultimate segment 10

9(8). Sides of head with a longitudinal keel or edge ..... *Ilybius*

———Sides of head lacking such a keel ..... *Agabus*

10(8). Mandibles wide at base, nearly half as wide as long and with a blunt projection on inner face; cerci with hairs above and below as well as along sides ..... *Colymbetes*

———Mandibles narrow at base, not more than one-third as wide as long and with a smooth inner face; cerci with hairs mainly along sides ..... *Rhantus*

11(6). A pair of long lateral gills on the six anterior abdominal segments ..... *Coptotomus*
——— Lacking such gills 12
12(11). Ligula apically bifid ..... *Acilius*
——— Ligula simple ..... *Thermonectus*
13(5). Head anteriorly dentate; ligula long; cerci absent ..... *Cybister*
——— Head anteriorly lacking dentition; ligula absent, or low and bilobed; cerci present ..... *Dytiscus*

PUPAE (Wilson 1923)

1. Posterior margins of first 6-7 abdominal segments raised into prominent transverse ridges dorsally; cerci short, stout and straight 2
——— Dorsal surface of abdomen smooth, without transverse ridges; cerci long, narrow and crooked, or club-shaped 5
2(1). Eighth abdominal segment much narrower than 7th; hindtibial spur large and prominent 3
——— Eighth segment nearly as wide as 7th; hindtibial spur scarcely visible 4
3(2). Larger, 30 mm long or more; styli in the form of stiff bristles; cerci simple and acute ..... *Cybister*
——— Smaller, 15 mm long or less; styli with a stout basal portion and a slender, terminal seta; cerci bifid and blunt ..... *Thermonectus*
4(2). Larger, 10 mm or more; styli with a short enlarged basal portion; anterior margin of pronotum three-fourths as wide as posterior margin ..... *Ilybius*
——— Smaller, 6 mm long or less; styli with a short, enlarged basal portion; anterior margin of pronotum only one-third as wide as posterior margin ..... *Agabus*
5(1). Anterior margin of pronotum much narrower than posterior margin; styli in the form of slender bristles, without enlarged basal portion 6
——— Anterior pronotal margin nearly as wide as posterior; styli with a short enlarged basal portion and a long terminal seta 7
6(5). Larger, 35-40 mm long; pronotum with two raised processes on anterior margin; cerci club-shaped and densely plumose ..... *Dytiscus*
——— Smaller, 17 mm long or less; anterior pronotal margin smooth; cerci crooked, tapering, sparsely setose ..... *Colymbetes*
7(5). Body densely covered with setae; cerci setose; hindtibial spine short and hardly discernible ..... *Hydroporus*
——— Body with few setae; cerci bare; hindtibial spine long and very prominent (5 supra-orbital styli above each eye) ..... *Coptotomus*

LACCOPHILINAE

LACCOPHILINI

LACCOPHILUS Leach, 1817 (Leech, 1948)

KEY TO SPECIES

Metasternum and metacoxal plates black, abdominal sternites largely picous; elytra densely and nearly uniformly irrorated with small, elongate brown spots; paler laterally and apically; epipleura yellow; male with a metacoxal file which is entirely lacking in female; average length slightly less than 5 mm ..... *atristernalis*

Underparts yellow or brownish-yellow ..... *decipiens*

L. decipiens Le Conte, 1852 (*L. fusculus* Sharp, 1882).—CHURCHILL CO.: (*Fallon* 29/XI/39, el. 3900 ft. –LaR); LYON CO.: (*Wabuska Hot Springs* 20/X/41, el. 4300 ft. –LaR & T. J. Trelease); MINERAL CO.: (*Monte Christo* (SE of Rawhide and not now listed on general state maps), C. T. Brues, 1930—Hot Springs No. 104 (38.3°C, sp. gr.

1.0037, pH 8.4)); NYE CO.: (*Beatty* (Amargosa river) 29/XII/46, el. 3375 ft. –LaR, T. J. Trelease, B. H. Banta & R. G. Miller; *Pahrump Ranch* (Pahrump Valley) 2/I/47, el. 2500 ft. –LaR, T. J. Trelease & B. H. Banta; *Sunnyside*, C. T. Brues, 1930—Hot Spring No. 97 (30.8°C, sp. gr. 1.0029, pH 9.3) (Brues 1932)); PERSHING CO.: (*29 mi. S of Winnemucca*, C. T. Brues, 1927—Hot Spring No. 20 (36.3°C, sp. gr. 1.0014, pH 8.6)) (Brues 1928); WASHOE CO.: (*Gerlach*, C. T. Brues, 1930—Hot Spring No. 108 (36.3°C, sp. gr. 1.0061, pH 7.5) (Brues 1932); *Wadsworth Slough* 20/IX/41, el. 4000 ft. –LaR & T. J. Trelease); WHITE PINE CO.: (*Monte Neva*, C. T. Brues, 1930—Hot Spring No. 96 (36.3°C, sp. gr. 1.0038, pH 8.4) (Brues 1932).

L. fusculus was originally described from "Nevada" in Dr. Sharp's comprehensive monograph, but the following year (1883), Dr. George Horn wrote: "*L. fusculus*, Shp., founded on one female specimen, does not appear separable from decipiens, Lec." Sharp considered it intermediate between *decipiens* and *atristernalis*.

L. decipiens is a common and well-distributed species in western Nevada. At the Wabuska locality, a number of *decipiens* were found floating in a hot pool lying in the middle of the hot spring area and surrounded by cooler pools and marshes. Water in the hot pool was too warm to immerse the hand in for more than a couple of seconds (146°F-49.1°C), and was lethal to all insects flying into it. At the south end, where all surface debris floated to the outlet, more than two hundred specimens of assorted insects were gathered, including, in addition to *L. decipiens*: *Tropisternus ellipticus, Coptotomus longulus, Cybister explanatus*, the bugs *Notonecta spinosa, N. kirbyi* and *Belostoma flumineum*, as well as two specimens of the common Toper dragonfly, *Sympetrum corruptum*, which latter had sunk to the bottom and were already heavily impregnated with minerals carried by the circulating waters. The hot water, cooking and hardening animal tissues, and the subsequent rapid deposition of mineral on and in the bodies by heavily-laden spring waters, is probably a favorable prelude to fossilization under certain conditions. The insect victims were still flying in while we watched, coming from adjacent cooler ponds and streams.

L. atristernalis Crotch, 1873.—CHURCHILL CO.: (*Sand Spring* 5/VII/41, el. 4500 ft. -LaR & G. C. Christensen); ELKO CO.: (*Ruby Valley*, C. T. Brues, 1927—Hot Spring No. 28 (no temperature given, sp. gr. 1.0009, pH 9.4)) (Brues 1928); ESMERALDA CO.: (*Fish Lake Valley* 12/I/40, el. 4500 ft. –LaR); HUMBOLDT CO.: (*Soldier Meadows* (35 mi. N of Gerlach in SW Humboldt County and not listed on general state maps), C. T. Brues, 1930—Hot Spring No. 113 (19.2°C, sp. gr. 1.0007, pH 8.8)); MINERAL CO.: (*Monte Christo* (SE of Rawhide, and not listed on state maps), C. T. Brues, 1930—Hot Spring No. 104 (38.3°C, sp. gr. 1.0052, pH 8.7)); NYE CO.: (*Darrough Hot Spring*, C. T. Brues, 1930—Hot Spring No. 102 (40.2°C, sp. gr. 1.0025, pH 9.0)) (Brues 1932); WASHOE CO.: (*Truckee Meadows* (Reno) 17/XI/39, el. 4500 ft. –LaR; *Wadsworth Slough* 20/IX/41, el. 4000 ft. –LaR & T. J. Trelease). Common and everywhere plentiful. The Sand Spring locality is a tiny alkaline pool some fifteen-by-twenty feet square, lying in alkaline ground about fifteen miles from the nearest water. Associated with *L. atristernalis* were *Tropisternus lateralis, Thermonectus basillaris, Cybister explanatus* and *Rhantus hoppingi*. The water is permanent. *L. atristernalis* was described from George Horn's California material.

The above records of Dr. Brues' were recorded by him as *Laccophilus mexicanus* Aubé 1838; until recently *L. atristernalis* was considered in the synonymicon of *mexicanus*, but the two seem distinct, and no authentic records of *L. mexicanus* are known for Nevada. As regards the species, Dr. Brues commented:

"This species would appear to extend its range northward in thermal waters through Nevada as the last locality" (Cedarville, California) "is in the extreme eastern part of California. Two of the records indicate rather high temperatures."

HYDROPORINAE

BIDESSINI

BIDESSUS Sharp, 1882

B. affinis (Say) 1823.—CHURCHILL CO.: (*Sand Springs* 5/VII/41, el. 4500 ft. –LaR & G. C. Christensen); ELKO CO.: (*Moline Cañon* (near Carlin), 22/VII/12 (Andrews

1917); *Ruby Valley*, C. T. Brues, 1927—Hot Spring No. 28 (38.0-42.5°C, sp. gr. 1.0009, pH 9.4); near *Wells*, C. T. Brues, 1927—Hot Spring No. 26 (32.5°C, sp. gr. 1.0018, pH 7.9)); HUMBOLDT CO.: (*6½ mi. S of Denio, Oregon* (a town on the state line), C. T. Brues, 1927—Hot Spring No. 9 (41.0°C, sp. gr. 1.0012, pH 8.5) (Brues 1928); *Soldier Meadows* (SW corner of county, not on maps), C. T. Brues, 1930—Hot Spring No. 113 (19.2°C, sp. gr. 1.0007, pH 8.8)) (Brues 1932); PERSHING CO.: (*Lovelock* 15/VI/41, el. 4000 ft. –LaR & G. C. Christensen); WASHOE CO.: (*Truckee Meadows* (Reno) 5/IV/41, el. 4500 ft. –LaR); WHITE PINE CO.: (*Cherry Creek*, C. T. Brues, 1930—Hot Spring No. 94 (no temperature recorded, sp. gr. 1.0038, pH 8.4), Hot Spring No. 95 (36.3°C, sp. gr. 1.0043, pH 8.4)) (Brues 1932). My specimens are all from normal waters, i.e., non-thermal.

The Moline Cañon specimens were taken by the Walker-Newcomb expedition of the University of Michigan to northeastern Nevada in 1912; base camp was established at Carlin, near the Elko-Eureka County lines, and some of the collections seem to have been made in the latter county—for the sake of convenience, Elko County, however, is assumed for all such material. Andrews' specific comment (1917) is: "Collected in pond west of bridge near Moline Cañon, July 22. This species has been taken at Fort Davis, Texas."

HYDROPORINI

HYGROTUS Stephens, 1828 (Fall 1919, 1928; Darlington, 1928)

KEY TO SPECIES

1. Venter entirely rufous or rufotestaceous; front generally margined; body broadly ovate and very convex ventrad 2
———Venter black; front not generally margined (except *fastidiosus*); form less broad and less convex, size generally larger 3
2(1). Elytral punctures unequal; front tarsi of male dilated ..... *hydropicus*
———Elytral punctures nearly uniform in size (elytra reddish-brown with markings); front male tarsi not dilated ..... *sayi*
3(1). Dorsum fulvo- or rufo-testaceous, elytra with distinct vittiform markings 4
———Dorsum flavo-, rufo-, or piceo-testaceous, or picous-brown, the elytral disc often with broad nubilous markings which are never distinctly vittate (venter black) 5
4(3). Clypeus margined ..... *fastidiosus*
———Clypeus unmargined ..... *semivittatus*
5(3). Elytra with intermixed coarser-and finer punctures, which are more-or-less generally diffused; elytra lacking markings 6
———Elytra nearly uniformly punctate, exception being made of the more-or-less evident sutural and two discal irregular series of coarser punctures visible, especially toward the base, in many species 7
6(5). More coarsely punctured, disparity in size of elytral punctures less marked in posterior half; second segment of male protarsus a little smaller and less triangular; body lighter in color, more ovate ..... *bruesi*
———Less coarsely punctured, disparity in elytral puncture-size more marked in posterior half; 2nd segment larger, more triangular; darker ..... *nigrescens*
7(5). Male protarsi broadly dilated, nearly or quite as wide as apical tibial width 8
———Male protarsi at most only moderately dilated 9
8(7). Male protarsi subequal in width to tibial apex ..... *infuscatus*
———Male protarsi less-widely dilated, not quite as wide as tibial apex ..... *collatus*
9(7). Male middle tibiae nearly parallel-sided except for a small lobe internally near base; hind femora broader than in the female ..... *thermarus*
———Male middle tibiae unmodified; femora similar in the sexes 10
10(9). Dorsum testaceous with large elytral cloud extending nearly to base; form slightly narrower, the size, as a rule, a little smaller than the next species ..... *lutescens*
———Dorsum nearly as in preceding species, but with elytral cloud less extended basally as a rule; elytral markings very variable in development, sometimes nearly lacking ..... *medialis*

H. hydropicus Le Conte, 1852 (*Coelambus*).—ELKO CO.: (near *Carlin*, 11/VII/12) (Andrews 1917). Andrews' note is: "Specimens of this species were collected among weeds in Maggie Creek, July 11." I have no specimens.

H. lutescens Le Conte, 1852 (*Coelambus*).—EUREKA CO.: (*Antelope Valley* (SSW of Eureka) C. T. Brues, 1930—Hot Spring No. 100 (35.8°C, sp. gr. 1.0038, pH 9.1)) (Brues 1932); HUMBOLDT CO.: (*6½ mi. S of Denio, Oregon* (a town on the state line), C. T. Brues, 1927-—Hot Spring No. 16 (39.0°C, sp. gr. 1.0015 pH 8.5(Brues 1927); *10½ mi. S of Denio, Oregon*, C. T. Brues, 1930—Hot Springs No. 118 (39.0°C, sp. gr. 1.0030, pH 8.4)); LANDER CO.: (*Cortez*, C. T. Brues, 1930—Hot Spring No. 103 (40.8°C, sp. gr. 1.0041, pH 8.5)); NYE CO.: (*Sunnyside*, C. T. Brues, 1930—Hot Spring No. 97 (30.8°C, sp. gr. 1.0029, pH 9.3)) (Brues 1932); WASHOE CO.: (*Truckee Meadows* (Reno) 1/VII/41, el. 4500 ft. –LaR); WHITE PINE CO.: (*Monte Neva*, C. T. Brues, 1930—Hot Spring No. 96 (36.3°C, sp. gr. 1.0038, pH 8.4)) (Brues 1932). Originally described from San Francisco.

H. medialis Le Conte, 1852 (*Coelambus*).—Fall (1919) makes specific mention of "Carlin, Nevada" (Elko County) in a long list of localities from California to Texas. Since he examined at least some of the material gathered about Carlin by the University of Michigan in 1912, this may be the source of his record. The species was originally described from San Diego. I have no specimens.

H. infuscatus (Sharp) 1882 (*Coelambus*).—This species was described from two females taken in "Nevada," and Dr. Sharp considered it close to *H. nubilus*. I have no specimens.

H. sayi Balfour-Brown, 1944 (*H. punctatus* (Say) 1824).—This species is known across the northern half of the United States. Fall (1919) notes "Carlin, Nevada" (Elko County) in a long list of localities. Individuals of this species have also been recorded in the literature as *H. inaequalis* (Fabricius) 1776, but Fall maintains the two are distinct. I have no specimens.

H. bruesi (Fall) 1928 (*Coelambus*).—ELKO CO.: (*Ruby Valley*, C. T. Brues, 1927—Hot Spring No. 28 (39.2-40.0°C, sp. gr. 1.0009, pH 9.4)) (Brues 1928, Fall 1928). This is the type locality, and it has since been found in Utah (Utah County (*Utah Lake* 6/VII/41, el. 4000 ft. –Harry P. Chandler). I have no specimens.

H. nigrescens (Fall) 1919 (*Coelambus*).—HUMBOLDT CO.: (*10½ mi. S of Denio, Oregon* (on the state line), C. T. Brues, 1930—Hot Spring No. 118 (39.0°C, sp. gr. 1.0030, pH 8.4)) (Brues 1932). I have no specimens.

H. thermarum (Darlington) 1928 (*Coelambus*).—HUMBOLDT CO.: (*Soldier Meadows* (SW corner of the county), C. T. Brues, 1930—Hot Spring No. 113 (19.2°C, sp. gr. 1.0007, pH 8.8)); LANDER CO.: (*Cortez*, C. T. Brues, 1930—Hot Spring No. 103 (44.5°C, sp .gr. 1.0041, pH 8.5) (Brues 1932); *Watt's Ranch*, C. T. Brues, 1927—Hot Spring No. 23a (30.0°C, sp. gr. 1.0021, pH 8.6)); PERSHING CO.: (*29 mi. S of Winnemucca*, C. T. Brues, 1927—Hot Spring No. 20 (38.0°C, sp. gr. 1.0014, pH 8.6)) (Brues 1928, 1932; Darlington 1928). Described from Nevada, and not known elsewhere. I have no specimens.

H. collatus (Fall) 1919 (*Coelambus*).—HUMBOLDT CO.: (*Soldier Meadows* (SW corner of the county), C. T. Brues, 1930—Hot Spring No. 113 (19.2°C, sp. gr. 1.0007, pH 8.8)) (Brues 1932); LINCOLN CO.: (*Alamo* 8/V/40, el. 3800 ft. –LaR); WASHOE CO.: (*Gerlach*, C. T. Brues, 1930—Hot Spring No. 108 (36.3°C, sp. gr. 1.0061, pH 7.5)) (Brues 1932). Described from southern California and also known from Arizona.

H. fastidiosus (Fall) 1919 (*Coelambus*).—WASHOE CO.: (*Pyramid Lake Pinnacles*, C. T. Brues, 1930—Hot Spring No. 106a (39.0°C, sp. gr. 1.0064, pH 8.4)) (Brues 1932). I have no specimens.

H. semivittatus (Fall) 1919 (*Coelambus*).—WASHOE CO.: (*Truckee Meadows* (Reno) 18/IV/40, 15/III/41, el. 4500 ft. –LaR). Originally described from an unique from Seligman, Arizona. Common in western Nevada.

DERONECTES Sharp, 1882 (Fall 1923)

KEY TO SPECIES

Elytra with several distinctly impressed and entire discal striae, the first scarcely more distant from the sutural striae than the latter is from the suture (form rather broad as a rule, distinctly less than twice as long as wide) ..... *striatellus*

Elytra with two lightly impressed or unimpressed discal series of coarser punctures, the first twice as distant from the sutural series as the latter is from the suture .... *griseostriatus*

D. griseostriatus (De Geer) 1774 (also *Hydroporus*).—ELKO CO.: (near *Carlin*, 12/VII/12) (Andrews 1917); WASHOE CO.: (*Fish Spring* (extreme N portion of county, unknown on maps), C. T. Brues, 1930—Spring No. 119 (cold, sp. gr. 1.0002, pH not taken) (Brues 1932); *Peavine Mountain* (near Reno) 9/VI/40, el. 6500 ft. –LaR; *Truckee Meadows* (Reno) 14/XI/39, el. 4500 ft. –LaR); WHITE PINE CO.: (*Monte Neva*, C. T. Brues, 1930— Hot Spring No. 96 (36.3°C, sp. gr. 1.0038, pH 8.4)) (Brues 1932). A common species. My Truckee Meadows specimens are typical, but the Peavine locality material is somewhat atypical. The locality here is a vernal pond in a small grassy meadow on a high ridge of the 8,270-foot peak. The pond dries completely in summer and becomes baked hardpan. The nearest of the surrounding permanent springs, all small, is at least a mile distant through heavy Jeffrey pine timber (*Pinus ponderosa jeffreyi*), and 500 feet higher in elevation.

D. striatellus (Le Conte) 1851 (also *Hydroporus*).—CLARK CO.: (*Hidden Ranch* (Pahrump Valley) 3/I/47, el. 2500 ft. –LaR, T. J. Trelease & B. H. Banta); LANDER CO.: (*26 mi. S of Battle Mt.*, C. T. Brues, 1927—Hot Spring No. 22 (34.5°C, sp. gr. 1.0014, pH 7.8)) (Brues 1928); NYE CO.: (*Beatty* (Amargosa river) 29/XII/46, el. 3375 ft. –LaR, T. J. Trelease, B. H. Banta & R. G. Miller); WASHOE CO.: (*Fish Spring* (extreme N part of county, unknown on maps), C. T. Brues, 1930—Spring No. 119 (cold, sp. gr. 1.0002, pH not taken) (Brues 1932); *Truckee Meadows* (Reno) 14/XI/39, el. 4500 ft. –LaR). Originally described from San Francisco and San Diego specimens.

HYDROPORUS Schellenberg, 1806 (Fall 1923)

1. Posterior coxal processes conjointly more-or-less angulate medially at tip 2
—Posterior coxal processes truncate at apex or nearly so, the tip at most only very slightly more advanced at middle than at sides 3
2. Elytra strikingly marked with four large and two small yellow spots (broad species, coarsely punctate above and below) ..... *quadrimaculatus*
—Elytra, at most, pale across base ..... *vilis*
3. Large, more than 6 mm long; form ovate, dorsum very finely or minutely punctate .. *fortis*
—Medium, 3.5 to 4.5 mm long; form oval, dorsum more distinctly punctate ..... *tenebrosus*

H. tenebrosus Le Conte, 1850 (*H. rusticus* Sharp 1882).—Sharp described *rusticus* from "North America, (Nevada)," and considered it similar to *H. tartaricus* Le Conte 1850. Fall (1923) indicated the present synonymy. I have no specimens.

H. fortis Le Conte, 1852.—WASHOE CO.: (*Truckee Meadows* (Reno), 10(x)39, el. 4500 ft. –LaR). I have it so far only in limited quantity from one locality in western Nevada. It is distinctive in being the largest species in the State fauna. Le Conte described it from San Diego, and listed it as rare. Mr. Chandler informs me (1946) it is now known quite commonly from both California and Oregon, so it is undoubtedly more widespread over Nevada than present records indicate.

H. vilis Le Conte, 1852.—In 1923, Fall mentioned "Nevada (without definite locality)," as part of the species' range. I do not have it.

H. quadrimaculatus (Horn) 1883.—This species was also originally described from "western Nevada," and Fall (1923) has added adjacent eastern California to the range. He further comments: "This is one of our rarest species and is represented in very few collections." The exact taxonomic position of *quadrimaculatus* has been a matter of much concern to recent workers. Hatch (1933) points out that Fall (1923) erred in placing the species with the Oreodytes group, since an examination of the mesial line between the

posterior coxal processes shows it to be, not abbreviated behind as is Oreodytes, but, as in more typical Hydroporus, extended caudad beyond the level of the lateral metacoxal processes. Hatch's proposal (1933) to expand Deronectes for *quadrimaculatus* does not seem to have been generally followed, and both this species and *picturatus* are lately considered as members of the genus *Neonectes* (*fide* Leech 1946) (group-terms used above are in the sense of subgenera). Being unable, at the present, to do more than follow the literature, I have retained Fall's old grouping, and append his 1923 description of this rare species as seemingly the only means whereby general collectors may be able to recognize it:

"Broadly oval, feebly shining, not pubescent. Head, antennae and legs entirely rufotestaceous; thorax piceous with a small transverse median spot and the side margins diffusely rufotestaceous; elytra with a large quadrate humeral spot, another at the apical third—both attaining the side margin but not the suture—and a small apical spot, of the same color. Head finely punctate; thorax rather sparsely and more coarsely so, especially toward the base, the interstices very finely, closely punctulate; elytra finely punctulato-reticulate, with numerous scattered coarse punctures on the disk, which become sparser and finer toward the sides and apex. Body beneath rufopiceous, alutaceous and dull, very coarsely punctate over the usual areas; prosternal process broad, but little longer than wide, feebly carinate medially.

"*Length* (fide Horn) 3 to 3.5 mm. The only specimen before me is a female, having a length of 3.8 mm.; width, 2.3 mm. Horn's types were said to be from Western Nevada. The single specimen at hand was collected by Dr. Blaisdell at Guerneville, Sonoma Co., California."

OREODYTES Seidlitz, 1887

O. picturatus (Horn) 1883 (also *Hydroporus*).—In his description, Horn wrote: "I have seen but four specimens collected in western Nevada." In 1923, Fall increased the range to adjacent eastern California. Hatch (1933) again mentions the Nevada record. I have no specimens.

COLYMBETINAE

AGABINI

AGABUS Leach, 1817 (Leech and Chandler in Usinger *et al.* 1948)

KEY TO SPECIES

1. Vittate species ..... (in part) *disintegratus*
———Non-vittate species 2
2(1). Prosternal process broad and only moderately convex 3
———Prosternal process narrow, varying from moderately convex to angularly or acutely carinate 4
3(2). Metasternal wings narrow, least distance from midcoxae to hindcoxal plates less than half the width of the latter, measured along the same line; more elongate, subparallel, rather flat species; elytral reticulation lightly impressed ..... *seriatus intersectus*
———Metasternal wings broad, least distance from midcoxae to hindcoxal plates more than half the width of the latter; oval, broader, more convex species; elytral reticulation more deeply impressed ..... *lugens*
4(2). Elytral reticulation coarse in both sexes, the individual meshes often about as wide as is a median antennal segment 5
———Elytral reticulation fine and minute in the male, coarser in the female 6
5(4). Large, 8.5 to 9.0 mm long; reddish-brown with metasternum and hindcoxal plates blackish; prosternal process glabrous ..... *austini*
———Medium, less than 7 mm long; black, elytra brownish or fuscous; prosternal process finely pubescent ..... *strigulosus*
6(4). Anterior male protarsal claw with a large tooth 7

———Anterior male protarsal claw not so toothed 8
7(6). Tooth of anterior male claw outstanding, nearly median in position .....*lutosus*
———Tooth subapical, not standing out at an angle .....*griseipennis*
8(6). Elytra black, sharply margined with reddish-yellow; pronotum rufotestaceous with an anterior and posterior transverse black band .....(in part) *disintegratus*
———Color not as above .....*obliteratus*

A. seriatus intersectus (Crotch) 1873.—Fall (1923) mentions this as extending "across the Great Basin to Nevada." Leech (1942A) again mentions Nevada for the range. More specific records were obtained from specimens in the collection of the California Academy of Sciences, viz.: LYON CO.: (*Smith Valley*, 26/VII/09—possibly some of F. W. Nunenmacher's collecting); WASHOE CO.: (*Franktown* (Washoe Valley)— C. W. Leng collection). I have no specimen.

A. lugens (Le Conte) 1852 (*A. suturalis* (Crotch) 1873).—ELKO CO.: (near *Carlin*, 24/VII/12) (Andrews 1917). Although giving the above listing, Andrews says: "Specimens of a form very near to this species were taken on the Carlin Peaks, July 24." Crotch described *suturalis* from some of Le Conte's "Nevada" material. Fall (1923) wrote that it extended "East to Nevada," etc., in listing its distribution. I do not have the species.

A. disintegratus (Crotch) 1873.—WASHOE CO.: (*Truckee Meadows* (Reno) 10/X/39, el. 4500 ft. –LaR). Apparently not common in Nevada.

A. lutosus F. E. Melsheimer, 1853.—WASHOE CO.: (*Truckee Meadows* (Reno) 1/I/41, 22/II/41, el. 4500 ft. –LaR). Common about Reno. Leech (1942A) mentions Nevada for a portion of its range.

A. obliteratus (Le Conte) 1859.—WHITE PINE CO.: (*Ely* 9/II/40, el. 6470 ft. –LaR). Leech (1942A) has "NEVADA, Reno; Zephyr Canon, Lake Tahoe."

A. griseipennis (Le Conte) 1859.—HUMBOLDT CO.: (*6½ mi. S of Denio, Oregon* (a town on the state line), C. T. Brues, 1927—Hot Spring No. 16 (39.0°C, sp. gr. 1.0015, pH 8.5)); LANDER CO.: (*Watt's Ranch*, C. T. Brues, 1927—Hot Spring No. 23a (36.0°C, sp. gr. 1.0021, pH 8.5)) (Brues 1928, 1932); WHITE PINE CO.: (*Monte Neva*, C. T. Brues, 1930—Hot Spring No. 96 (36.3°C, sp. gr. 1.0038, pH 8.4)) (Brues 1932). Fall (1923) listed "Nevada (a male in the Sharp collection correctly referred); Humboldt Lake, Nevada (Wickham Collection);" (Churchill-Pershing Counties). Leech (1942A) mentions Nevada as part of the range. I do not have the species.

A. strigulosus (Crotch) 1873.—WASHOE CO.: (*Truckee Meadows* (Reno) 2/III/41, el. 4500 ft. –LaR). In his description, Crotch had "California. (Leconte) Lake Tahoe."

A. austini Sharp, 1882.—WASHOE CO.: (*Truckee Meadows* (Reno) 2/III/41, el. 4500 ft. –LaR). The only known Nevada locality. Fall (1922B) recorded Truckee in adjacent eastern California as part of the range. Sharp's original specimens came from "North America (British Columbia)."

Agabus tristis dubius (Mannerheim) 1843.—Recorded by Crotch (1873) as "Thorax entirely black—Lake Tahoe" (California). It is certain to be found on the Nevada side of the lake.

ILYBIUS Erichson, 1832

I. fraterculus Le Conte, 1862—WASHOE CO.: (*Truckee Meadows* (Reno), 10(x)39, 3(viii)41, el. 4500 ft. –LaR.; *Wadsworth Slough*, 20(ix)41, el. 4070 ft. –LaR & T. J. Trelease). Common in western Nevada, and the only species of the genus so far known for the State.

COPTOTOMINI

COPTOTOMUS Say, 1834

C. longulus Le Conte, 1852.—LYON CO.: (*Wabuska Hot Springs*, 20(x)41, el. 4300 ft. –LaR & T. J. Trelease); WASHOE CO.: (*Truckee Meadows* (Reno) 10(x)39, 8-15(iii)41, 24(viii)41, el. 4500 ft. –LaR). One of the commonest western Nevada aquatics. See *Laccophilus decipiens*.

COLYMBETINI

RHANTUS Dejean, 1833 (Chandler 1947)

KEY TO SPECIES

Pro-episternum pale ..... *hoppingi*
Pro-episternum dark ..... *longipes*

R. longipes Sharp, 1882 (also spelled *Rantus*).—ELKO CO.: (near *Carlin*, 22/VII/12) (Andrews 1917); WHITE PINE CO.: (*Cherry Creek*, C. T. Brues, 1930—Hot Spring No. 85 (30.4°C, sp. gr. 1.0043, pH 8.4); *Monte Neva*, C. T. Brues, 1930—Hot Spring No. 96 (35.3°C, sp. gr. 1.0038, pH 8.4)) (Brues 1932). According to Harry P. Chandler (1946), this is probably the species recorded from various western localities as *R. binotatus* (Harris) 1828. It is so-listed by Dr. Brues for the above Nevada records, as well as by Andrews, while Crotch (1873) makes specific mention of "Nevada" as part of the range of *R. binotatus*. I have no specimens.

R. hoppingi Wallis, 1933.—CHURCHILL CO.: (*Sand Spring* 5/VII/41, el. 4500 ft. –LaR & G. C. Christensen); ESMERALDA CO.: (*Fish Lake Valley* 28/I/40, el. 4500 ft. –LaR); WASHOE CO.: (*Truckee Meadows* (Reno) 10/X/39, 18/V/40, el. 4500 ft. –LaR); *Wadsworth Slough* 20/IX/41, el. 4000 ft. –LaR & T. J. Trelease). The commonest of the medium-sized dytiscids in the State. The holotype came from Trinity Valley, British Columbia, and the species was then known as far south as Washington (1933). See *Laccophilus decipiens*.

Dr. Brues lists a "*Rhantus* sp. near *divisus* Aubé" 1838 for Humboldt County (6½ *mi S of Denio, Oregon* (a town on the state line), C. T. Brues, 1927—Hot Spring No. 16 (39.0°C, sp. gr. 1.0015, pH 8.5)) (Brues 1928). Possibly *R. longipes*.

COLYMBETES Schellenberg, 1806

C. rugipennis Sharp, 1882.—WASHOE CO.: (*Truckee Meadows* (Reno), 10(x)39, 8(iii)41, el. 4500 ft. –LaR). A large, common species.

DYTISCINAE

DYTISCINI

DYTISCUS Linné, 1758 (*Dyticus*) (Hatch 1928)

Metacoxal process obtuse; scutellar disc pale; female elytra smooth ..... *marginicollis*
Metacoxal process spinose; scutellar disc dark; female elytra smooth or sulcate (dimorphic) ..... *circumcinctus*

D. marginicollis Le Conte, 1844.—LANDER CO.: (*Watt's Ranch*, C. T. Brues, 1927—Hot Spring No. 23 (30°C, sp. gr. 1.0008, pH 8)) (Brues 1928); WASHOE CO.: (*Truckee Meadows* (Reno), 12(viii)41, el. 4500 ft. –LaR); WHITE PINE CO.: (*Ely*, 15(iii)40, el. 6470 ft. –LaR). Commonly found over the entire State in suitable localities.

D. circumcinctus Ahrens, 1811.—WHITE PINE CO.: (*Ely*, 15(iii)41, el. 6470 ft. –LaR). So far I have it only from this locality in the eastern part of the State.

HYDATICINAE

THERMONECTINI

ACILIUS Leach, 1817

A. semisulcatus Aubé, 1838.—WASHOE CO.: (*Truckee Meadows* (Reno) 11(iv)40, 18(v)40, el. 4500 ft. –LaR). A very common species, with sulcate elytra in the female.

THERMONECTUS Dejean, 1833

T. basillaris (Harris) 1829.—CHURCHILL CO.: (*Fallon* 29(viii)40, el. 3960 ft. –LaR; Sand Spring 5(vii)41, el. 4500 ft. –LaR & G. C. Christensen); WASHOE CO.: (*Truckee Meadows* (Reno) 20(vi)40, el. 4500 ft. –LaR; *Wadsworth Slough* 20(ix)41, el. 4000 ft. –LaR & T. J. Trelease). A very common species.

CYBISTERINAE

CYBISTER Curtis, 1827

C. explanatus Le Conte, 1852.—CHURCHILL Co.: (*Sand Springs* 5(vii)41, el. 4500 ft. -LaR & G. C. Christensen); LYON Co.: (*Wabuska Hot Springs* 20(x)41, el. 4300 ft. -LaR & T. J. Trelease); WASHOE Co.: (*Truckee Meadows* (Reno) (10(x)39, 12(vii)41, el. 4500 ft. -LaR). A common, large species. See *Laccophilus decipiens* and *L. atristernalis*. Dr. Brues lists a "*Cybister* sp." from Churchill County (*Sou Hot Springs* (N. end of Dixie Valley), C. T. Brues, 1927—Hot Spring No. 21 (31.6° C, sp. gr. 1.0020, pH 8.1)) (Brues 1928) which is very probably this species, the only one yet known for the State. The known distribution at the time of its description was given as "ad San Diego, Colorado et Sacramento minus frequens."

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A Revision of the Nearctic Species of the Genus Gaurax (Diptera, Chloropidae)

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The genus *Gaurax* was erected by Loew in 1863 for a strikingly pretty American species, *G. festivus*. Since then, many species have been described under that generic name in all the faunal regions, but the species often have little or no relation to the genotype. In particular, there has been confusion with *Pseudogaurax* Malloch, a situation which has been discussed by Sabrosky (1945). In Europe, typical *Gaurax* species have commonly been called *Botanobia*. All species treated in the present paper will trace to *Gaurax* without much difficulty in the most readily available key to the Nearctic genera of Chloropidae (Curran, 1934, "The Families and Genera of North American Diptera," pp. 341-344).

Within a period of a few years (1906-1915), several keys to the American species of *Gaurax* were published. Since 1915, however, the genus has seldom been noted in the literature, and only one new species was added to the known Nearctic fauna. The genus is relatively rare in collections, and this scarcity of material has long handicapped study. Earlier papers were based on no more than two or three dozen examples at most, whereas approximately 240 specimens have been studied for the present paper. Types of all species considered in this paper have been personally examined, except for the European *dubius*, *ephippium*, and *fascipes*.

GAURAX Loew

Loew, 1863, Berlin. Ent. Ztschr. 7: 35 (Centuria 3, no. 66). Type, *G. festivus* Loew (Monobasic).
Czerny, 1906, Wien. Ent. Ztg. 25: 301 (Key to 8 spp., 2 Palaearctic).
Becker, 1912, Ann. Mus. Nat. Hung. 10: 74 (Key to 6 spp., 4 now in *Pseudogaurax*).
Johnson, 1913, Psyche 20: 34 (Key to 4 New England spp.).
Malloch, 1915, Ent. Soc. Wash. Proc. 17: 160 (Key to 10 spp.).
Malloch, 1915, Ill. State Lab. Nat. Hist. Bul. 11: 360-361 (Key to 13 spp.).
Collin, 1939, Ent. Monthly Mag. 75: 150-151 (Notes on *Gaurax* and *Botanobia*).
Sabrosky, 1945, Zool. Soc. London Proc. 114: 457-459 (*Gaurax* and *Pseudogaurax*).

Synonyms: Neogaurax Malloch, 1914, Canad. Ent. 46: 119. Type, *G. montanus* Coquillett (By original designation). *Botanobia* Lioy, 1864, Atti Ist Veneto (3) 9: 1125. *Type: Oscinis dubia* Macquart. (Actually monobasic, for one of the two species mentioned is a *nomen nudum*. *Oscinis dubia* was also designated type by Coquillett, 1910, U. S. Natl. Mus. Proc. 37: 515.)

Generic diagnosis: Eye distinctly pilose, large and occupying most of head as seen in profile, the long axis vertical in typical species, somewhat diagonal in others; cheek usually linear to sublinear, never over one-fifth the height of an eye; facial carina weak to absent; proboscis short; antenna usually rather

large, the third segment strikingly reniform, distinctly broader than long; arista long pubescent; both inner and outer vertical bristles well-developed, approximately as long as the postverticals, the ocellars slightly shorter; postvertical and ocellar bristles erect and cruciate; fronto-orbitals conspicuous, subequal in length to the ocellars.

Thorax generally shining, without pollen, the mesonotum clothed with numerous fine hairs that in the males are sometimes long, pale, appressed, and silky in appearance; scutellum of the *Oscinella*-type, short and semicircular in outline, decidedly broader than long, the disk gently convex; chaetotaxy: 1 humeral, typically 1+1 notopleural (upper posterior sometimes present but short and weak), 1 postalar, 1 posterior dorsocentral, 1 apical and 1-2 marginal scutellars, the apicals more or less widely separated.

Legs relatively weak; distinct "sensory area" posterodorsally on hind tibia.

Wing with a characteristic habitus that is difficult to express in words, the outstanding features being the distinctly broadened marginal cell, which is broader than the submarginal, and the strongly curving second vein (cf. figs. 11-13).

Length: 1.5-2 mm. throughout the genus, occasionally smaller.

Distribution: In North America, *Gaurax* (*s. str.*) ranges throughout southeastern Canada and northeastern United States, west to Alberta (Edmonton, Bilby) and South Dakota and south to North Carolina and Louisiana. There is also a published record from Biscayne Bay, Florida, but it is an old record which should not be accepted without verification. Skinner's 1903 record of a *Gaurax* from Beulah, New Mexico, proved to belong to another genus (see under *G. dubius*). Specimens of the genus are so uncommon in collections, however, that more intensive collecting of small Diptera in other parts of the country, especially by such methods as close inspection of tree trunks and branches, may greatly extend the known range of the genus.

Variation: Considerable variation in extent of color pattern is indicated from the series of *G. pseudostigma* and *G. dorsalis*, the latter being one of the few species where a reasonably adequate series is available. This suggests that similar variation, when recognized, may require some modification of the status of such pairs of related species as *apicalis* and *montanus*, and perhaps of *dubius* and *melanotum*. Generally speaking, however, the new species described in this paper differ so markedly (e.g., *basitarsalis, mesopedalis,* etc.) that variation great enough to sink them in synonymy is almost inconceivable.

Adult habits: There are a number of records of Gaurax being collected on tree trunks or branches, and of being collected in the course of ecological studies of forest areas.

Larval habits: A few species have been reared. The little knowledge of habits in the genus, or in almost the entire family for that matter, makes it desirable to cite the records even though they are not definitive as to the exact feeding habits of the larvae. Detailed data are given under the species named. It seems likely that the larvae do not do any direct damage, but feed in the frass of other insects, or on decaying plant tissues.

G. atripalpus: Oakland County, Mich., reared from a "large polyporous

bracket fungus" containing considerable frass and sediment, for over a thousand beetles (*Dorcatoma* spp. and *Ennearthron* sp.) emerged from the same fungus.

G. dorsalis: Ames, Iowa, reared from dying plant of *Taraxacum officinale* [record published by Sweetman, 1928].

G. dorsalis var.: Urbana, Ill., "reared . . . from elder stems [Sambucus]".

G. maculicornis: Petersham, Mass., reared from pine shoots infested with *Pissodes strobi*.

G. pallidipes: Morristown, N. J., "larvae from bird nest"; Bell, Md., "bred from catbird nest."

G. shannoni: Westchester County, N. Y., "reared elm sect."

G. vittipes: Hull's Cove, Maine, "emerged . . . from material of scolytid on *Pinus resinosa*." A female, Dwight, Ontario, "Ex *Pissodes strobi*," may also belong here.

G. apicalis and *G. montanus* (determinations not verified): New York, "reared from moist elm bark" [Pechuman, 1937, Brooklyn Ent. Soc. Bul. 32(1) : 20]. Dr. Pechuman kindly furnished the following information on the circumstances of the rearing: "The material from which they emerged was brought into the laboratory during the winter and kept at a high temperature for the emergence of *Hylurgopinus rufipes*. . . . The material was part of the trunk of a large elm and contained mature larvae of *H. rufipes* and *Saperda tridentata*. Some adults of both species of beetles had emerged the previous season, and the inner bark was completely decayed" (Pechuman in litt., Dec. 11, 1937).

ACKNOWLEDGMENT

I am particularly indebted to Dr. A. L. Melander for the loan of the holotype of *Oscinella pilosula* Becker to complete my knowledge of the types in the genus; to Mr. J. R. Malloch for making available his excellent private collection with its many specimens of *Gaurax*; and to the curators of the collections cited in this paper for the loan of material. Study of most of the types in this genus was made possible some years ago by Grant No. 352 from the Bache Fund of the National Academy of Sciences.

Collections in which material is located are indicated by the following abbreviations: USNM, U. S. National Museum; AMNH, American Museum of Natural History; MCZ, Museum of Comparative Zoology, Harvard University; KU, Snow Collection, Kansas University; INHS, Illinois Natural History Survey; CNC, Canadian National Collection.

KEY TO GAURAX AND RELATED GENERA

1. Ocellar bristles proclinate and divergent; third antennal segment suborbicular, nearly as long as broad, not reniform; second costal sector much longer than third sector, and marginal cell at its middle obviously narrower than submarginal; notopleural bristles 1+1 ..... *Oscinoides* Malloch

   Ocellar bristles erect and cruciate or convergent; third antennal segment typically reniform to subreniform, broader than long; second costal sector only slightly longer than third sector, second vein strongly curved and marginal cell at its middle obviously broader than submarginal cell opposite it 2

2. Scutellum more or less elongate conical, the disk flattened; apical scutellar bristles approximated, subapicals absent or not distinct from hairs; notopleural bristles 1+2 (at least in North American species) ..... *Pseudogaurax* Malloch

   Scutellum of the usual *Oscinella*-type, short and semicircular in outline, the disk

gently convex; apical scutellar bristles more or less widely separated, 1 to 2 pairs of distinct marginal scutellars; notopeural bristles typically 1+1, or the upper posterior so weak as to appear absent ..... *Gaurax* Loew

KEY TO THE NEARCTIC SPECIES OF GAURAX

1. Knob of halter black[1]; scutellum black [Group A] 2
Knob of halter black[1]; scutellum yellow [Group B] 5
Halter entirely yellow; scutellum black [Group C] 16
Halter entirely yellow; scutellum yellow[2] [Group D] 18

[Group A—Both knob of halter and scutellum black]

2. Legs pale yellow; wing of male partly infuscated (♂, ♀) ..... 1. *G. pallidipes* Malloch
Legs with some black marks, at least on hind legs 3
3. Mid femur with broad median black band, widest in female; male wing clear (♂, ♀) ..... 2. *G. varihalteratus* (Malloch)
Mid femur entirely yellow 4
4. Hind femur on distal two-thirds and hind tibia on basal three-fourths, black (♂) ..... 3. *G. fumipennis* (Malloch)
Hind femur black on distal third to two-fifths, rest of legs yellow (♀) ..... 4. *G. pilosulus* (Becker)

[Group B—Knob of halter black; scutellum yellow]

5. Basal segment of tarsus on fore and middle legs black; at least mid and hind tibiae with black markings 6
All tarsi yellow 7
6. Mesonotum predominantly yellow, with a few black spots (fig. 1); mid and hind tibiae each with broad black band on median third, the fore tibia pale yellow; third antennal segment predominantly yellow, the dorsal fourth to third black (♂) ..... 5. *G. basitarsalis*, n. sp.
Mesonotum predominantly black, the notopleuron white and with some yellow mesad of it; all tibiae with narrow stripe on middle third to half of posterior surface; third antennal segment predominantly black, only a small testaceous spot on inner surface at base below (♂) ..... 6. *G. atrilinea*, n. sp.
7. Thorax predominantly yellow to reddish, the mesonotum reddish with pattern of black (figs. 2, 3, 4); wing heavily infuscated anteriorly in known males (cf. fig. 11) 8
Thorax predominantly black, the lower half of pleuron yellowish, and usually the notopleuron slightly paler than surrounding areas; any reddish areas on mesonotum (fig. 5) distinctly less extensive than the black; wing clear in most of known males (weakly infuscated in small area in male of *apicalis*) 11
8. Distal third to two-fifths of middle tibia black, and black markings on both hind femur and hind tibia; pleuron almost entirely yellow, with a small mesopleural spot; mesonotal pattern as figured (fig. 2) (♂) ..... 7. *G. festivus* Loew
Middle tibia not so marked; upper half of pleuron extensively infuscated 9
9. Mesonotum as figured (fig. 3), the black markings chiefly on posterior half, and on each side a large and conspicuous white spot occupying most of notopleuron; femora and tibiae of both mid and hind legs usually marked with black areas (♂) ..... 8. *G. splendidus* Malloch
Mesonotum not as figured for *splendidus*, featured mainly by a broad median black stripe, and not with a conspicuous white spot on each side 10
10. Mesonotum as figured (fig. 4), with a broad median black stripe or partial stripe, and on each side a postsutural spot or partial stripe; legs almost entirely yellow,

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1 At least the outer half of the knob.

2 At least in part. Sometimes the scutellum is browned at the base and on the sides, or rarely on the disk, but it is always in large part yellow and clearly unlike those species with all black scutellum.

at most the hind femur with a narrow preapical fuscous streak posteroventrally; antenna entirely yellow (♂, ♀) ..... 9. *G. tripus*, n. sp.

Mesonotum not as above, with a broad median black stripe for the entire length; legs with more extensive brown to black markings, especially on posterior surface of hind femur toward apex, and a narrow stripe along posterior surface of middle tibia; third antennal segment black except narrowly at base (♂) ..... 10. *G. obscuripennis* Johnson

11. Ocellar tubercle conspicuously gray pollinose; front relatively narrow, 1.6 times the width of an eye (♀) ..... 11. *G. ocellaris*, n. sp.

Ocellar tubercle more or less shining, not pollinose; front proportionately broader, at least twice the width of an eye 12

12. Mesonotum as figured (fig. 5), with two testaceous sublateral spots which demarcate a broad median stripe on anterior half; legs yellow, with narrow fuscous stripe along basal half of anterior surface of hind tibia, and narrow ring at knee on hind femur (♂) ..... 12. *G. semivittatus*, n. sp.

Mesonotum not as above, usually entirely black, at most slightly paler on notopleuron and at ends of mesonotal suture; legs otherwise marked 13

13. Both mid and hind femora with black marks on apical fourth of posterior or posteroventral surfaces, especially strong on hind femur; tibiae entirely yellow; wing of known male faintly browned at middle, between costa and third vein (♂, ♀) ..... 14. *G. apicalis* Malloch

Not so, the middle femur unmarked, hind tibia with some infuscation in one species; wing of known males hyaline (unknown in *maculicornis*) 14

14. Hind tibia with narrow sublinear areas of infuscation on both anterior and posterior surfaces; hind femur with anterior and anterodorsal infuscation in addition to the strong preapical posterior spot (♂) ..... 13. *G. vittipes*, n. sp.

Hind tibia entirely pale yellow; hind femur with only the preapical posterior spot 15

15. Front predominantly black, more or less yellowish at anterior margin; third antennal segment browned dorsally and anteriorly along margin (♂, ♀) ..... 15. *G. montanus* Coquillett

Front entirely yellow, the frontal triangle thus sharply outlined back to its base; third antennal segment with dorsal fourth to third black, forming a conspicuous and rather sharply delimited spot (near fig. 9 but black less extensive) (♀) ..... 16. *G. maculicornis*, n. sp.

[*Group C—Halter yellow; scutellum black*]

16. Thorax entirely black; palpus black 17

Thorax predominantly yellow, with black pattern on disk of mesonotum (figs. 6, 7) and mesopleuron; palpus yellow (♀, ♂) ..... 17. *G. dorsalis* (Loew)

17. Head and antenna brown to black; palpus inconspicuous, shorter than haustellum; frontal triangle not polished but subshining, the surface minutely wrinkled; legs yellow, with narrow preapical black bands on all femora, and with narrow subbasal bands on mid and hind tibiae (♀) ..... 18. *G. maculipes*, n. sp.

Head and antenna with considerable yellow, front entirely yellow and the small, smooth and polished black frontal triangle in strong contrast; palpus large and conspicuous, longer than haustellum; legs yellow, mid and hind femora black on distal three-fourths to four-fifths and the corresponding tibiae black on middle third to two-thirds (♂, ♀) ..... 19. *G. shannoni*, n. sp.

[*Group D—Both halter and scutellum yellow*]

18. Disk of mesonotum with a single large spot 19

Disk of mesonotum predominantly yellow to reddish, with black markings, if any, in the form of three stripes or partial stripes (♂, ♀) ..... 20. *G. pseudostigma* Johnson

19. Fore and hind legs pale yellow, middle leg distad of trochanter entirely black except for whitish distal fourth of tibia; dorsum of thorax black except for notopleura and humeri; both meso- and pteropleuron largely black; occiput, and frontal triangle except anteriorly, black (♂; female probable) ..... 21. *G. mesopedalis*, n. sp.

Legs entirely pale yellow; one or more of other characters not as above 20
20. Palpus black, relatively large and conspicuous; wing of male with small irregular markings at about middle of wing (fig. 12) (♂, ♀) .....22. *G. atripalpus*, n. sp.
Palpus yellow; wing hyaline in both sexes 21
21. Disk of mesonotum with large, shining black, posteriorly tridentate spot, like that of *G. dorsalis* (cf. fig. 7); occiput black on upper half; at least the mesopleuron with large and distinct spot, and usually ptero-and hypopleuron with brown and less distinct spots (♀, ♂?) .....23. *G. dubius* (Macquart) (*ephippium Zetterstedt*)
Disk of mesonotum not with posteriorly tridentate spot, either all black up to humeri and notopleura, or the posterior half black; pleuron entirely yellow, unspotted 22
22. Disk of mesonotum broadly black up to humeri and notopleura; occiput black on upper third to half (♂, ♀) .....24. *G. melanotum*, n. sp.
Disk of mesonotum broadly black on about posterior half, as a subquadrate spot; occiput yellow .....24a. *G. melanotum* var.

OSCINOIDES Malloch

Oscinoides arpidia Malloch, 1916, Brooklyn Ent. Soc. Bul. 11: 86-87 (Illinois, South Dakota). *O. arpidia* varr. *atra, humeralis, elegans* Malloch, 1918, Brooklyn Ent. Soc. Bul. 13: 19-20 (Illinois). *Gaurax dorri* Johnson, 1925, Psyche 32: 47 (Maine). [New synonymy, equalling *O. arpidia* var. *atra*, from the types of both].

The genus *Oscinoides* has been included in the key because it somewhat remembles *Gaurax*, and because it was necessary to dispose of one of the described species of *Gaurax* by reference to it. *Oscinoides* was not included in Curran's 1934 key to the genera of Chloropidae, in which it would probably trace to *Gaurax*, although the aristal pubescence is not as long as in the latter.

Some years ago (Sabrosky, 1936, Ent. Soc. Amer. Ann. 29: 719), I was in error in relegating *Stenoscinis* Malloch to synonymy under *Oscinoides*. The two are amply distinct in fundamental characters, the slenderness of legs, wings and body being a relatively superficial resemblance.

Oscinoides arpidia occupies approximately the same range as *Gaurax*, for I have seen specimens from Georgia, Illinois, Iowa, Maine, New York, North Carolina, South Dakota, Texas and Virginia.

GAURAX Loew

The groupings used in this paper are purely artificial, designed to aid in identification by using certain stable and easily applied characters for the initial division of the species. In several cases, such as in Groups A and C, the resultant species groups are composed of unquestionably closely related species, but in the present state of our knowledge, such approximations to a natural classification are purely coincidental. The group characters were selected after considerable study to find stable characters common to both sexes, after it was noted that one of the main features used in published keys (infuscated wings) was found only in males.

GROUP A—Both knob of halter and scutellum black

Dark species that will remind one of *Oscinella*, with which they have indeed often been confused. The upper posterior notopleural bristle is quite well-developed, nearly equalling the lower in some cases and giving the appearance of 1 + 2 notopleurals.

Four described species belong here, but their status is not yet entirely clear. It is possible that only one good species exists in nature, or perhaps two for *varihalteratus* seems a little different. It is also possible, however, that the current distinctions, minor though they seem, are actually significant, and that all four names can be maintained as valid. For the present, therefore, all four are recognized until adequate material is available to reach more definite conclusions.

1. GAURAX PALLIDIPES Malloch

Malloch, 1915, Ill. State Lab. Nat. Hist. Bul. 11: 362 (Illinois).

♂, ♀.—Black, the lower half of third antennal segment, palpus, and legs entirely, yellow; front yellowish to orange anteriorly, brown to black posteriorly; notopleural bristles 1 + 2, the upper posterior only slightly shorter and weaker than the lower.

Sex differences: Third antennal segment noticeably larger in males; bristles black in female, yellowish in male; mesonotal hairs longer, paler, and more silky in appearance in male than in female; wing hyaline in female, but in males more or less browned on the anterior half toward the base, though this may be faint in teneral specimens; male terminalia conspicuously yellow on the ventral (distal) half.

Specimens examined: 4 (2 ♂♂, 2 ♀♀), Morristown, N. J., May, 1925, "larvae from bird nest—Apr." [AMNH]; ♂, Bell, Md., Nov. 18, 1926, "bred from catbird nest No. 10, Mar. 20, '27" (W. L. McAtee) [USNM]; 2 ♂♂, Nantucket, Mass., Aug. 6, 1929, and Norwich, Vt., July 8, 1908 (C. W. Johnson) [Boston Soc. Nat. Hist.].

2. GAURAX VARIHALTERATUS (Malloch)

Botanobia varihalterata Malloch, 1913, Canad. Ent. 45: 274 (District of Columbia). *Gaurax varihalterata* (Malloch) Sabrosky, 1936, Ent. Soc. Amer. Ann. 29: 728.

♂, ♀.—Black, the front slightly paler anteriorly, palpus brown, basal antennal segments and part of third segment orange, and inner half of halter knob yellow; legs predominantly yellow, with brown to blackish marks as follows: middle half to two-thirds of mid femur, distal two-thirds or more of hind femur, and proximal third of hind tibia; wing hyaline in both sexes; frontal triangle and ocellar tubercle polished black; front rather shining; antenna relatively small in both sexes; notopleural bristles apparently 1 + 1, the upper posterior present but short and weak, only half the length of the lower and not usually evident.

Sexual differences: Bristles black in female, at least some yellow in male; mesonotal hairs short and dark in female, longer, paler and somewhat silky in male; male terminalia large, brown to black; leg markings seem consistently fainter in male sex, and in some examples the mid femur is scarcely infuscated.

Specimens examined: ♀, Dubois, Ill., May 22, 1917 [Malloch Colln.] 9 (5 ♂♂, 4 ♀♀), same locality, May 21-23, 1917 [INHS].

I have seen two females with the original data published by Malloch, and each labeled type, one in the U. S. National Museum and one in Malloch's collection. The original description specified the type locality, but did not designate the holotype nor state how many specimens were involved. Inasmuch as the specimen in the Museum collection, which was received from W. L.

McAtee, bears Malloch's original handwritten label as "type," I designate that specimen as Lectotype.

It is very possible that this species may be confused with *pallidipes*, especially in teneral specimens for which color characters must always be applied with caution and understanding.

3. GAURAX FUMIPENNIS (Malloch)

Neogaurax fumipennis Malloch, 1915, Ent. News 26: 108 (Illinois). *Gaurax fumipennis* (Mall.), Malloch, 1915, Ent. Soc. Wash. Proc. 17: 160.

The holotype [INHS] is a male, not a female as originally stated. The claspers are curved beneath the abdomen and difficult to detect.

Diagnosis (from description and my notes on type): Black, the basal antennal segments and basal to ventral half of the third segment yellow, and palpus brown; legs yellow, with black on the distal two-thirds of the hind femur and proximal three-fourths of the hind tibia.

Male characters: Reasoning by analogy with material of the two preceding and closely related species, the long, silvery or silky appearing mesonotal hairs and the infuscation of the wing on the basal half of the anterior third are almost certainly characteristics only of the male sex of this species.

A series of six specimens (2♂ ♂, 4♀♀), Rock Creek, D. C. (R. C. Shannon), labeled "Feb. 10, 1913, issued March 31, 1913" but without indication of source, may belong here. The wings are hyaline and the legs yellow, but the specimens are extremely teneral and such pallor is thus to be expected. The hind legs seem to show faint traces of the typical pattern.

4. GAURAX PILOSULUS (Becker)

Oscinella pilosula Becker, 1912, Ann. Mus. Nat. Hung. 10: 111 (Louisiana). (in key, p. 106, as *pilosella*, corrected by Becker, 1912, op. cit. 10: 645). *Gaurax pilosula* (Becker) Malloch, 1915, Ent. Soc. Wash. Proc. 17: 159-160. *Gaurax pilosulus* (Becker) Malloch, 1915, Ill. State Lab. Nat. Hist. Bul. 11: 361.

Holotype female: Opelousas, La., April, 1897 [Melander Colln.].

The holotype female has been examined through the courtesy of Dr. Melander. It may be characterized briefly as follows: Predominantly black, the small antenna predominantly orange with third segment narrowly brown on dorsal and anterior margins, palpus brown, and legs yellow with black only on distal two-fifths of hind femur (except flexor surface); wing clear. Front slightly over half the width of head (.53); frontal triangle smooth and polished, short and broad, its apex a 90° angle; cheek sublinear; notopleural bristles 1 + 2, the upper posterior nearly as long and as distinct as the lower bristle.

I have seen no specimens that can positively be referred here, but one female, Edmonton, Alberta, 1932 (Owen Bryant) [Malloch Colln.] is quite probably this species. It has been compared with the type, and differs in that the hind femur is black on only the distal fourth of the posterior surface, a difference which is probably merely of degree.

GROUP B—Knob of halter black; scutellum yellow

5. Gaurax basitarsalis, new species

♂.—Predominantly yellow, with dark brown to black marks as follows: Dorsal fourth of third antennal segment, frontal triangle except apically, occiput, mesonotal pattern as figured (fig. 1), a narrow stripe along hind margin and an elongate-oval spot along lower margin of mesopleuron, anterodorsal half of pteropleuron, metanotum, large knob of halter, and abdomen except base; legs with distinctive color pattern of a series of rather sharply marked, broad black bands of about equal length, including the fore and middle basitarsi except narrowly at their bases, and the median third of mid and hind tibiae; hairs short and erect, silvery in some lights but not long, silky and appressed as in many males of the genus; bristles chiefly black; wing hyaline, at least in the sole available specimen.

Frontal triangle rather short and broad; third antennal segment large, subreniform, narrow dorsally but broadening ventrally; cheek sublinear; notopleural bristles strong, 1 + 1, with no trace of an upper posterior bristle; second costal sector, between first and second veins, one and one-half times the third sector.

Holotype male: Massachusetts, July 10 (L. H. Taylor) [MCZ].

Because of the color pattern of the legs, this species is one of the most distinctive of the entire genus.

6. Gaurax atrilinea, new species

♂.—Predominantly black, marked with yellow as follows: Basal antennal segments, a small spot on inner surface of third segment at base below, cheek, notopleuron (white), a small spot mesad of and adjoining the notopleuron, scutellum, lower half of pleuron, and stalk of halter; legs yellow, marked with black as described in key, the stripes on posterior surfaces of tibiae a distinct feature; wing distinctly browned on anterior half, anterior to the fourth vein, and in the discal cell.

Front broad, at the vertex over twice the width of an eye and slightly over half the width of the head (.55); frontal triangle short and broad, polished black; ocellar tubercle not pollinose, slightly roughened, subshining; cheek linear; notopleural bristles 1 + 1; mesonotal hair moderately long and pale.

Holotype male: Cold Spring Harbor, Long Island, New York, July. [Melander Colln.].

In this specimen, the femora are orange on the distal third to half (broadest on hind femur), in contrast to the pale yellow basal portions, and the hind femur has a small black spot midway on the dorsal surface, suggesting that variation in other specimens might even show some black markings on the femora. The lower part of the head is somewhat discolored, and though the palpi appear black, it is possible that this is not the natural color.

Gaurax atrilinea, together with *G. basitarsalis*, is separated from all others in the genus by the black basitarsi on the fore and middle legs.

7. GAURAX FESTIVUS Loew

Loew, 1863, Berlin. Ent. Ztschr. 7: 35 (Centuria 3, no. 66) (Pennsylvania).

♂.—Predominantly yellow, with dark brown to black marks as follows: Dorsal two-fifths of third antennal segment (fig. 9), ocellar tubercle and basal third of frontal triangle up to level of median ocellus, occiput except narrowly below, mesonotal pattern as figured (fig. 2), an elongate-oval anteroventral spot on mesopleuron, metanotum, knob of halter, and abdomen except towards base; mesonotum darker yellow than rest of body, almost orange; legs pale yellow, black on the distal third to two-fifths of mid tibia, median third of hind tibia, a strong preapical oblique spot on posterior to posteroventral surface of hind femur, and a slight browning at middle of dorsal surface of hind femur; mesonotal hairs short and erect, silvery, but not long and silky; bristles pale yellow to whitish; wing rather extensively browned on anterior half.

Front short and broad, entirely yellow back to the vertical bristles and the black basal portion of the triangle well demarcated; frontal triangle narrow, its base only about .7 times the width of front at vertex, and well separated from each eye; third antennal segment large, reniform; notopleural bristles 1 + 1.

♀.—Unknown. (See discussion under *G. apicalis*, no. 14.)

Specimens examined: ♂, Beverly, Mass., July 20, 1871 (Burgess); ♂, Cabin John, Md., Oct. 20, 1931 (J. M. Aldrich) [USNM]; ♂, Chain Bridge, Va., Aug. 20, 1922 (J. R. Malloch) [Malloch Colln.].

This species, the oldest in the genus but apparently quite rare, can easily be confused with *splendidus* Mall., but the mesonotal patterns are actually somewhat different (cf. figs. 2 and 3), and with the other characters used in the key should separate them without much trouble.

The Cabin John specimen cited above is much the darkest of the three, but the fundamental mesonotal pattern is still evident, merely a little more extensive.

8. GAURAX SPLENDIDUS Malloch

Malloch, 1915, Ent. Soc. Wash. Proc. 17: 161 (Illinois).

♂.—Extensively if not predominantly yellow, marked with dark brown to black as follows: Ocellar tubercle and basal third of frontal triangle up to level of median ocellus, occiput, mesonotal pattern as figured (fig. 3), upper half of pleuron, metanotum, large halter knob, and abdomen except base; legs pale yellow with black markings on femur and tibia of both mid and hind legs, the markings somewhat irregular and not solid, but occupying approximately the distal half of mid femur and distal two-thirds of hind femur, and the mid and hind tibiae except narrowly at each end, the markings on hind leg darker than on mid leg, those on the latter often elongate, linear; mesonotum outside of black areas deep yellow to orange, in rather strong contrast to the whitish-yellow scutellum and to the large white spot on each side that occupies almost all of the notopleuron; hairs as in *basitarsalis;* bristles whitish yellow; wing strongly browned on the anterior half, paling toward the apex of the wing (fig. 11).

Proportions of front and triangle about as in *festivus*, the triangle slightly broader at base; antenna not unusually large, the third segment only subreniform, dorsal half much less rounded than the lower (fig. 10); notopleural bristles 1 + 1.

♀.—Unknown. (See discussion under *G. apicalis*, no. 14).

Specimens examined (all males): "D.C." June; Lafayette, Ind., July 17, 1916 (J. M. Aldrich); Great Smokies National Park, 1500 ft., Gatlinburg, Tenn., June 17, 1947 (R. H. Whittaker); 2, Nashville, Tenn., May 21, July 16, 1932 (R. H. Adams), [all USNM]; Glen Echo, Md., July 10, 1923 (Malloch [Malloch Colln.]; 4, Chain Bridge, Va., Aug. 20, 1922 (J. R. Malloch) [USNM, MCZ, 2 in Malloch Colln.]; Dubois, Ill., May 22, 1917, and Dongola, Ill., May 6, 1919 [INHS]; Urbana, Ill., July 4, 1915, tree trunk [Sabrosky Colln.]; ♂, Nomininque, Quebec. June 13, 1941 (O. Peck) [CNC].

Variation: In dark specimens, the black areas on the mesonotum may be quite extensive, though as noted for *festivus* the fundamental pattern is always preserved. In such dark specimens, the white notopleural spots are even more striking than usual. The distal half of the posterior surface of the fore femur may also be infuscated.

9. **Gaurax tripus,** new species

♂, ♀.—Predominantly yellow, bright yellow below but orange on mesonotum, with dark brown to black markings as follows: Arista, ocellar spot, occiput except narrowly below, mesonotal pattern as figured (fig. 4), most of meso- and pteropleuron so as to appear that the upper half of the pleuron is black, metanotum, abdomen except base, knob of halter (at least on outer surface), and a narrow fuscous streak preapically on the posteroventral surface of the hind femur; bristles chiefly pale yellow, entirely so in some examples.

Front relatively short and broad, 1.44 times as broad as long, and at the vertex over twice the width of an eye (2.17 times); frontal triangle smooth and shining, small and apparently nearly equilateral, actually 1.2 times as long as broad, at its base only .67 times the width of the front, and its length .83 times that of the front; cheek linear; notopleural bristles 1 + 1 with no trace of an upper posterior bristle; second costal sector 1.6 times the third sector.

Sexual differences: Third antennal segment slightly larger in male; mesonotal hairs long, silky, and silvery shining in male, shorter and not so silky in female; male terminalia moderately large, knoblike, shining black; wing of female clear, of male extensively browned except on posterior fourth to third.

Holotype male: Knoxville, Tenn., Aug. 18, 1939 (D. E. Hardy). *Allotype:* Cheboygan County, Mich., June 24, 1940 (R. I. Sailer). Type and allotype in the Snow Colln., University of Kansas. *Paratypes:* ♂, North Fork, Swannanoa, Black Mt., N. C., May (N. Banks) [MCZ]; ♀, Chester, Mass., July 25, 1913 (C. W. Johnson) [USNM].

Variation: The mesonotal pattern shown in fig. 4 is that of the holotype male. The paratype male shows a faint narrow connection between the median spot and the black area above the neck. The allotype appears at first glance to have the stripe broad up to the neck, but close examination shows that there is a narrow break. Finally, in the paratype female, the stripe is of full width up to the neck. From these degrees of difference, it is inferred that only

normal variation is involved. The last named specimen also does not show the black streak on the hind femur.

Specimen in poor condition might be confused with females of *pseudostigma*, especially if the halteres are damaged or discolored. The latter species may otherwise be distinguished by its characteristic mesopleural spot, hind tibial band (if evident), wider cheek, and dull frontal triangle.

10. GAURAX OBSCURIPENNIS Johnson

Johnson, 1913, Psyche 20: 35 (Massachusetts).

♂ (from holotype)—Predominantly yellow, with brown to black markings as follows: Large third antennal segment (except for linear rufous area at base), ocellar tubercle, occiput, a median stripe on entire length of mesonotum, wide anteriorly and narrowing slightly posteriorly, the posterior half or more of notopleuron, most of mesopleuron, metanotum centrally, abdomen except base, large knob of halter, the large and knoblike male genitalia, apical third of posterior surface of hind femur, and a linear stripe almost the full length of posterior surface of hind tibia. The wing, as in the males of *festivus*, *splendidus*, and *tripus*, is definitely infuscated, in this species on the basal half or more, and anterior to the fifth longitudinal vein. Bristles pale yellow; mesonotal pairs pale. Notopleural bristles 1 + 2, but the upper posterior short and weak.

Holotype: Chester, Mass., Aug. 7, 1912 (C. W. Johnson) [MCZ]—the only specimen known to me.

11. **Gaurax ocellaris**, new species

♀.—With predominantly black habitus, because of the black frontal triangle, posterior half of front, occiput, entire mesonotum, upper half of pleuron, metanotum, abdomen, and halter knob; arista except basal segment, and third antennal segment except narrow semicircle at base, dark brown; bristles and hairs predominantly black; legs yellow, with distal fourth of mid and hind femora brown to blackish, the color especially solid on posterior surface of hind femur, paler on anterior surface, and especially pale and inconspicuous on both surfaces of mid femur; wing clear.

Front relatively long and narrow in appearance, but the breadth at vertex measuring 1.16 times the length of the front, and 1.6 times the width of an eye; frontal triangle short, only two-thirds as long as the front, smooth and polished; ocellar tubercle distinctly gray pollinose; cheek sublinear; notopleural bristles 1 + 1.

Holotype female: Detroit, Michigan, July 11, 1943 (George Steyskal). Deposited in the U. S. National Museum (Type No. 59291) through the courtesy of the collector. *Paratype:* ♀, Savanna, Ill., Aug. 8, 1946 [USNM].

The gray pollinose ocellar tubercle is a distinctive feature that sets this species apart from any other species in the genus, at least in the Nearctic region.

One male, Opelousas, La., April, 1897 [Melander Colln.] is probably the male of this species, but because of slight doubt I have not called it the allotype. It will key out easily to *ocellaris* because of the pollinose ocellar spot, but it differs from the description of the female as follows: Frontal triangle

yellow anterior to the median ocellus; mesonotum with a conspicuous white spot on each side, including the notopleuron and posthumeral areas; basal third of hind tibia brown. Besides these, two other differences which would be normal for the male sex are the long silky hair of the mesonotum and the infuscation of the anterior half of the wing, the infuscation being barely discernible. All in all, the differences could reasonably be expected to be part of the range of variation of one species.

12. **Gaurax semivittatus,** new species

♂.—Predominantly dark habitus, with black frontal triangle, posterior half to three-fifths of front, occiput, mesonotum except for two reddish spots at figured (fig. 5), upper half of pleuron, metanotum, abdomen, male terminalia, and large knob of halter. Legs yellow with the only marks a narrow brown apical ring on the hind femur, and a narrow brown stripe on the basal half of anterior surface of hind tibia; wing clear.

Front relatively broad, at the vertex slightly over twice the width of an eye and 1.4 times as broad as long; frontal triangle about four-fifths the length of the front, smooth and polished, the sides slightly convex and the triangle appearing large; ocellar tubercle minutely wrinkled but subshining, with no trace of pollen; arista relatively short, only 1.2 to 1.3 times the breadth of third antennal segment, notopleural bristles 1 + 1.

Holotype male: Great Smokies National Park, 3,500 ft., Gatlinburg, Tenn., July 19, 1947 (R. H. Whittaker). U. S. National Museum Type No. 59292. *Paratypes:* 2 ♂♂, same locality, 3,500 ft., June 19, 1947 and 3,100 ft., July 21, 1947 [USNM]; ♂, Waquoit, Mass., July 16, 1924 [AMNH].

The mesonotal pattern, with the two reddish spots outlining the anterior part of a broad median stripe, is characteristic for the species, as is the color pattern on the hind leg.

13. **Gaurax vittipes,** new species

♂.—As described for *Gaurax semivittatus* except as follows: Mesonotum entirely black; legs with more extensive black markings on hind leg, including a dorsal to anterodorsal vitta on the middle third to half of the hind femur, an apical band on hind femur that on the anterior surface is barely longer than broad but occupies one-third of the posterior to posteroventral aspect, and narrow brown stripes on both anterior and posterior surfaces of the hind tibia.

Third antennal segment reniform, large, black on dorsal half; arista black, unusually long, over twice the breadth of the third antennal segment.

Holotype male: Hull's Cove, Maine, emerged June 1944 from material of a scolytid on *Pinus resinosa.* U. S. National Museum Type No. 59293.

This species is closely related to *semivittatus,* but the distinctive color pattern of both mesonotum and legs of the latter, together with such other points as the length of the arista, justify its separate recognition.

One female, Dwight, Ontario, March 18, 1948, "Ex *Pissodes strobi*" [CNC] may possibly be the female of *vittipes.* The markings on the hind femur and tibia are somewhat more extensive than in the holotype.

13a. GAURAX sp. near VITTIPES

One female, Carp Lake, Emmet County, Michigan, July 16, 1938 (C. W. Sabrosky) [Sabrosky Colln.] resembles *vittipes* in many respects but has the lower half of the pleuron black to dark brown, and the hind tibia infuscated on its entire basal half. I hesitate to associate this example with *vittipes*, nor does it yet seem advisable to describe it as new without additional evidence.

14. GAURAX APICALIS Malloch

Malloch, 1915, Ent. Soc. Wash. Proc. 17: 160 (Illinois).

♂, ♀.—Predominantly dark habitus because of the black frontal triangle, posterior third to half of the front, occipus, mesonotum, upper half of pleuron, metanotum, abdomen except narrowly at base, and knob of halter; legs pale yellow, typically with distinct brown to black marks on apical fourth of posterior to posteroventral surfaces of mid and hind femora, that on the hind femur clearly the largest and most evident of the two.

Front appearing nearly square, but at the vertex measuring 1.2 to 1.35 times as broad as long, and nearly twice the width of an eye; frontal triangle smooth and shining, extending four-fifths of distance to anterior margin of front; ocellar tubercle minutely rugose, but subshining and not pollinose; cheek linear; notopleural bristles 1 + 1.

Sexual differences: third antennal segment of male larger than in female, and brown to black except for a small semilunar area at base, that of the female only weakly browned dorsally and distally; wing clear in female, faintly browned in male between the first and third veins and anterior to the two crossveins.

Specimens examined: 14 ♀♀, Chain Bridge, Va., Aug. 20, 1922 (J. R. Malloch) [Malloch Colln.], and 2 ♀♀, same data [MCZ]; 2 ♀♀, Glen Echo, Md., June 15, 1924 and Aug. 22, 1922 (Malloch) [Malloch Colln.]; 1 ♀, Wisconsin Dells, Wis., Aug. 18, 1939 (Sabrosky), 1 ♀, Norwich, Vt., July 8, 1908 (C. W. Johnson), 1 ♀, Elizabeth, Ill., July 8, 1917 [Sabrosky Colln.]; 3 ♀♀, Lafayette, Ind., July 13, 1915, June 26 and July 8, 1916 (J. M. Aldrich) [USNM]; 1 ♂, Philadelphia, Pa. [ANSP]; 1 ♀, Mt. Washington, N. H. (Mrs. Slosson) [AMNH].

Variation: Distinctness of the apical marks on the mid and hind femora varies considerably and that on the middle femur is more often only a linear mark posteroventrally on the distal fourth of the femur. In all cases, however, it is clear that both mid and hind femora are infuscated at those points, compared with the two following species (*montanus, maculicornis*) in which the mid femur is pale yellow and without a trace of infuscation. The notopleuron is sometimes pale, possibly due in part to the condition of the specimen.

Malloch regarded *splendidus* as the male of *apicalis*, and this was accepted by Aldrich and so identified and recorded in his card catalogue at the museum, though I cannot find that either ever published the synonymy. Because of several problems in association of sexes in the genus, a discussion of the available evidence is pertinent.

On August 20, 1922, Malloch collected an unusually long series of

Gaurax at Chain Bridge, Va., of which I have seen 24 specimens (5 ♂♂, 19 ♀♀), chiefly in Malloch's collection. Each sex appeared to be a uniform series, but quite different from the other sex, and under the circumstances of collection it was inferred that they represented opposite sexes of a strikingly dimorphic species, of which the males were being called *splendidus* and the females *apicalis*.

Upon examining the series in minute detail, in conjunction with other material available for this revision, it was clear that two distinct species of males were present, and apparently two species of females, though the latter were less distinct:

♂♂:	4 spms., *splendidus*	♀♀:	16 spms., *apicalis*
	1 spm., *festivus*		3 spms., *maculicornis*

It is natural to suspect that the males and females can be paired off by species in some combination, especially since *splendidus* and *festivus* are known only from the male sex, and *maculicornis* only from the female. *Splendidus* and *festivus* are so unlike that they are unquestionably distinct species, the lone example of the latter probably having been ovrlooked when the series was originally studied. Likewise, *maculicornis* is distinct from *apicalis* though the two are not as different as are the males. As between the sexes, however, they differ from each other in characters that are reliable specific differences throughout the genus, and not merely in the features that have been found to be sexually dimorphic (antennae, wing infuscation, mesonotal hairs). Furthermore, the finding of a male that agrees with *apicalis* in all respects except the normal secondary sexual characters strengthens the conclusion that *apicalis* is not the female of either *splendidus* or *festivus*.

Accordingly, improbable as it might at first seem, I am forced to conclude that four different species were by chance represented in the one collection, and to deny the suggested synonymy of any of the names involved. All four belong to the same "group" of species as here recognized, but that is not necessarily of special significance in view of the admittedly artificial grouping.

Finally, it must be admitted that *maculicornis* could possibly prove to be the female of *splendidus* or *festivus*, but it would represent a sexual dimorphism so extreme for the genus, or for any chloropid, that the possibility must be regarded as remote.

15. GAURAX MONTANUS Coquillett

Coquillett, 1898, N. Y. Ent. Soc. Journ. 6: 48 (New Hampshire).

♂, ♀.—As described for *G. apicalis* Malloch, differing only in having the mid femur yellow and unmarked, and the front predominantly black, usually only a semicircular yellow area along the anterior margin before the apex of the frontal triangle. The wing of the lone male is clear, without infuscation.

Lectotype: hereby designated, female, "Mt. Wash.," collected by Mrs. A. T. Slosson, bearing red label "Type No. 3804, U.S.N.M.," and Coquillett's name label [USNM]. The species was described from two specimens without a clearly designated holotype.

Specimens examined: 3 ♀♀, same data as type; ♀, Dead Run, Va., July 15, 1915 (R. C. Shannon); ♀, Franconia, N. H. (Mrs. Slosson) [USNM]; ♀, Glen Echo, Md., July 17, 1921 (J. R. Malloch) [Malloch Colln.]; 2 (♂, ♀), Dubois, Ill., May 22, 23,

1917 [Sabrosky Colln.]; ♀, Mt. Washington, N. H. (Mrs. Slosson) [AMNH]; ♀, Delaware Water Gap, N. J., July 12 (C. W. Johnson); ♀, Norwich, Vt., July 7, 1908 (C. W. Johnson [MCZ]; ♀, Aweme, Manitoba, June 17, 1925 (R. D. Bird) [CNC]; 8 ♀♀, Laniel, Quebec, June 29, July 3, 8, 10, 11, 1933 [CNC].

Variation: As in *apicalis*, there is variation in the size of the femoral spot. Typically, the spot on the hind femur is large and distinct, covering almost the distal fourth of the posterior surface, larger below than above. Sometimes the spot is greatly reduced, however, and may be only a posteroventral streak.

The darker front gives this species a somewhat different habitus than either *apicalis* or *maculicornis*, though in teneral specimens this difference is not likely to be as pronounced.

16. **Gaurax maculicornis**, new species

♀.—As described for *G. apicalis*, differing by the yellow front, the distinctly spotted third antennal segment as described in the key (near fig. 9 but black less extensive), and entirely yellow mid femur.

The yellow color of the front ends posteriorly in an abrupt line just in front of the inner vertical bristles. The definiteness of the antennal spot is especially remarkable for the female sex, as females of other species usually show only vague infuscation over both dorsal and distal areas of the segment. The preapical spot on the posterior surface of the mid femur is smaller than that of *montanus*, and is usually approximately square, being about the diameter of the femur at that point.

Holotype female: Petersham, Mass., Sept. 21, 1925 (H. J. MacAloney). U. S. National Museum Type No. 59294.

This specimen (holotype female) was reared from terminal shoots of the eastern white pine infested by white-pine weevil, *Pissodes strobi* (Peck). It was recorded as a primary parasite of the weevil by MacAloney (1930, N. Y. State Coll. of Forestry, Publ. 28, p. 50), but from other records of *Gaurax* it seems more likely to be a scavenger in the frass.

Paratypes: ♀, Franconia, N. H. (Mrs. Slosson) [USNM]; 3 ♀♀, Chain Bridge, Va., Aug. 20, 1922 (J. R. Malloch) [Malloch Colln.]; ♀, E. Falmouth, Mass., Aug. 10, 1924 [Sabrosky Colln.]; ♀, Forest Park, Ill., July 12, 1934 (DeLong and Ross, "white pine") [INHS]; ♀, Grand Bend, Ontario, July 11, 1939 (G. E. Shewell) [CNC].

Had the yellow front occurred in only one specimen, it might have been dismissed as a variant of *montanus* or *apicalis*, even with the antennal spot, but the consistent association of the two characters in these eight females justifies separate recognition.

GROUP C—Halter yellow; scutellum black

17. GAURAX DORSALIS (Loew)

Oscinis dorsalis Loew, 1863, Berlin. Ent. Ztschr. 7: 38 (Centuria 3, no. 72) Pennsylvania). *Gaurax dorsalis* (Lw.) Malloch, 1915, Ent. Soc. Wash. Proc. 17: 159.

This species appears to be the most common one of the genus, from the number and range of the available records. It is also one of the most easily recognized species, with the large, black, posteriorly bi- or tridentate mesonotal

spot, coupled with the combination of yellow halter and black scutellum. It may be characterized briefly as follows:

♂, ♀.—Yellow, marked with black as follows: Arista except basal segment, third antennal segment in large part (sometimes only narrowly infuscated above and at apex), ocellar spot, upper third to half of occiput, characteristic spot on mesonotum (figs. 6, 7), scutellum, metanotum, elongate oval spot on lower margin of mesopleuron, and abdomen; legs apparently typically with infuscation on dorsal portion of distal fourth to third of mid and hind femora, especially the latter, though only testaceous in many specimens; wing clear in both sexes.

Front broad, its width at vertex slightly over half the width of the head (.51), and subequal the length of the front; frontal triangle two-thirds the length of the front; cheek silvery, only moderately narrow, its height half the breadth of the third antennal segment and less than one-fifth the height of an eye (.18). Notopleural bristles 1 + 1, but the upper posterior bristle is represented by a pale hair over half the length of the lower posterior bristle.

Specimens examined: 60 (27 ♂♂, 32 ♀♀, 1 ?) from Alberta (Bilby), Illinois (Dubois, Elizabeth, Oregon, Savanna, Urbana, White Heath), Indiana (Lafayette), Iowa (Dickinson Co.), Manitoba (Aweme), Maryland (Glen Echo), Massachusetts (Auburndale, Beverly, Eastham, Waquoit), Michigan (Ann Arbor, Hart, South Haven), Minnesota (St. Paul), New Hampshire (Franconia, Mt. Washington), New York (Cold Spring Harbor), Ohio (Summit Co., Lakeside), Ontario (Brockville, Grandbend), Pennsylvania (Ephrata), Quebec (Abbotsford), Saskatchewan (Conquest), South Dakota (Brookings, Elk Point), Tennessee (Gatlinburg, 2,700 ft.), Virginia (Glencarlyn). May 16-July 26, Aug. 8-9.

In addition to these records, the species has also been recorded in the literature from New Jersey (Seaside Park, Morgan) and Iowa (Ames). The specimens from Winnipauk, Conn., recorded as *G. dorsalis* by C. W. Johnson (1925, List of the Diptera or two-winged flies of New England, p. 278) are actually another chloropid, *Dicraeus wilburi* Sabrosky.

Reared specimens: 10 (5 ♂♂, 5 ♀♀), Urbana, Ill., Jan. 2, 16, 23, Feb. 18, 23, Mar. 22, 1928, "reared by W. V. Balduf from elder stems [*Sambucus*] coll. Oct. 29, 1927." [INHS]. The Ames, Iowa specimens, determined as *dorsalis* by Aldrich, were reared from a dying plant of *Taraxacum officinale* (Sweetman, 1928, Ent. Soc. Amer. Ann. 21: 598).

Two color forms have been encountered, but the discovery of intermediates finally led to the conclusion that they are only color variations within one species. In one form (fig. 7), the male genitalia are yellow and the black area on the mesonotum lacks the supraalar vittulae but has a narrow median stripe connecting the discal spot and the black scutellum. In the other form (fig. 6), the male genitalia are black, the supraalar vittulae are present and joined to the main discal spot, and the latter ends abruptly without a median connection with the scutellum.

The exact relationship of the two forms is not yet clear, but because of variation within each form and the discovery of a few intermediate individuals, it is concluded that they are not recognizably discrete units. The holotype is a female and so pinned as to virtually obliterate the characteristic portions of the mesonotal pattern, but I believe that it represents the first form mentioned

above, which is the commoner of the two. One male (Waquoit, Mass., July 16, 1924), has the mesonotal pattern of this common form, but has the black genitalia of "*dorsalis* var."

Variation in the extent of black areas on other structures also affects the habitus of individual specimens. The third antennal segment varies from predominantly testaceous with the dorsal fourth infuscated to almost entirely black. The occiput varies from having only a narrow black band between the eyes, not connected with the black ocellar tubercle, to entirely black on the whole upper half. The pleuron in most specimens has only the elongate mesopleural spot, but a few specimens show a spot in the anteroventral angle of the pteropleuron. Finally, the legs in some specimens show definite infuscation on the distal fourth to third of mid and hind femora, especially dorsally and sometimes also anteriorly and posteriorly, but in other specimens these areas are only deeper yellow compared with the pale yellow of the remainder of the legs.

In the darkest individual (♀, South Haven, Mich., July 5, 1938, C. W. Sabrosky coll.), the black mesonotal pattern is so extensive that only the posterior half of each humerus, the notopleura, and two circular eyelike spots just before the scutellum, are yellow. In this individual, the dark habitus is further accentuated by the black dorsal half of the third antennal segment, upper half of occiput, pteropleural spot, and strong black markings on mid and hind femora.

18. **Gaurax maculipes,** new species

♀.—Predominantly black, the face and cheeks brown, halter yellow, and legs yellow, marked with dark brown to black as follows: Mid and hind femora with preapical bands, slightly longer than the femoral diameter at that point, and mid and hind tibiae with subbasal bands of the same length and directly opposite the femoral bands when the legs are flexed; fore femur with a preapical spot on outer surface in same position as on the other femora, and with faint indications that in dark specimens the band might be complete and the fore tibia might also have a corresponding subbasal band; wing clear.

Third antennal segment small but reniform, slightly broader than long (1.17 times); cheek narrow, sublinear; triangle moderately large, .7 times the length of the front, its surface finely rugulose, not smooth and polished; head slightly collapsed, so that the proportions cannot be stated accurately, but the width of the front at the vertex appears to be subequal to the length; thorax predominantly polished, but with areas of brown pollen about the base of the wing, on the upper half of the mesopleuron, and on the scutellum; notopleural bristles 1 + 1, the upper posterior represented only by a short weak hair; abdomen shining, but sparsely evenly brown pollinose on entire surface.

Holotype female: East Lansing, Mich., June 8, 1939, collected on window (C. W. Sabrosky), deposited in the U. S. National Museum, Type No. 59295. *Paratype female:* Dubois, Ill., May 22, 1917 [INHS].

The banded color pattern of the legs will distinguish this species from any others in the genus. The general habitus is not that of a typical *Gaurax*, but

rather suggests the genus *Oscinella*. After considering the sum total of its characters, however, especially the reniform third antennal segment and the notopleural bristles, I have placed it in *Gaurax*, but it must be admitted that it is a somewhat intermediate form. In the genus *Gaurax*, it is most closely related to *G. varihalteratus*, another somewhat atypical species, but the use of distinct though rather artificial group characters separates the two rather widely in the key.

19. **Gaurax shannoni,** new species

♂, ♀.—Predominantly black, with yellow front, face, cheek except lower margin, antenna except upper margin of third segment, base of arista, and halter; fore leg entirely yellow, mid and hind femora black on distal three-fourths tc four-fifths except narrowly at knee, and mid and hind tibiae black on middle third to two-thirds; cheek heavily covered with silvery pollen, especially conspicuous in certain lights; wing clear in both sexes; male genitalia polished black, unusually large and conspicuous.

Frontal triangle smooth and polished, extending three-fourths of way to anterior margin of front and especially conspicuous because of the entirely yellow front; width of front at vertex slightly greater than its length, and about half the width of the head; in profile the shape of the head as in *dorsalis*, the long axis of the eye distinctly diagonal and the cheek broader than usual in the genus, though still narrow, the height of the cheek nearly one-fifth the height of an eye and .4 times the breadth of the third antennal segment; palpus large and conspicuous, often projecting as far as the vibrissal angle or beyond; thorax polished, the scutellum finely brown pollinose; notopleural bristles 1 + 1, the upper posterior represented by a short weak hair.

Holotype male and *allotype:* Plummer's Island, Md., May 9, 1914 (R. C. Shannon), mounted on same point and probably taken in copula. U. S. National Museum Type No. 59296. *Paratypes:* 2, type locality, May 14 (♂) and 23 (♀), 1914, both taken at light (R. C. Shannon); ♂, Dead Run, Fairfax County, May 21, 1914 (Shannon) [USNM]; ♀, Black Rock Mt., 3,000 ft., Rabun County, Georgia, May 20-25, 1911 [Cornell Univ. Colln.]; ♀, Waubamic, Ontario, June 14, 1915 (H. S. Parish) [Cornell Univ. Colln.]; ♂, Oregon, Ill., June 20, 1917 [INHS]; ♀, Jeffrey, N. H., June 16, 1923 (C. W. Johnson) [MCZ]; ♀, Lower Westchester County, N. Y., June 2-6, 1934, "reared elm sect." (A. P. Jacot) [Malloch Colln.].

One female from Bryson City, N. C., May, 1936, 3-5,000 ft. (R. C. Shannon) is very dark, but probably belongs here.

The male and female of this species, in contrast to other species of the genus, do not differ markedly in the development of the third antennal segment, length of mesonotal hairs, or infuscation of wings.

From the form of the head, this species is most nearly related to *G. dorsalis*, near which it happens to come in the artificial key.

GROUP D—Both halter and scutellum yellow

20. GAURAX PSEUDOSTIGMA Johnson

Johnson, 1913, Psyche 20: 35 (Toronto, Ontario) [♂, not ♀ as stated in description]. *Gaurax flavidulus* Malloch, 1915, Ill. State Lab. Nat. Hist. Bul. 11: 361 (♂, Illinois),

[New synonymy]. *Gaurax interruptus* Malloch, 1915, l.c.: 363 (♀; Illinois), [New synonymy].

♂, ♀.—Predominantly yellow to reddish, with only the following parts dark brown to black: Occiput except narrowly below, ocellar tubercle, three thoracic vittae or parts of three (sometimes only reddish), usually an oval spot along lower margin of mesopleuron, metanotum (at least upper portion), abdomen chiefly, dorsal spot on male genitalia, spot in wing of male (see discussion of variation, and fig. 13), and, typically, a narrow band on the hind tibia at the proximal end of the "sensory area."

Frontal triangle short, extending only two-thirds of the way to the anterior margin of the front, finely rugulose, so the surface only subshining, not polished; cheek narrow, silvery pollinose, the vibrissal angle rounded and the oral margin receding rapidly; notopleural bristles 1 + 1.

Specimens examined: 10 (5 ♂♂, 5 ♀♀), Franklin, N. C., Aug. 17, 1939 (R. H. Beamer, D. E. Hardy) [KU]; ♂, Grosse Isle, Wayne Co., Mich., July 16, 1948 (George Steyskal) [Sabrosky Colln.]; ♀, Falls Church, Va., Aug. 6 (N. Banks); ♀, Great Pond, Mt. Desert, Maine, July 16, 1918 (C. W. Johnson); 2 ♀♀, Woods Hole, Mass., July 23, 1903 (C. W. Johnson) [MCZ, the Maine and Massachusetts specimens determined by Johnson as *interruptus*]; ♀, Frasher, Iowa, July 23, 1926 (W. E. Shull) [Univ. of Idaho Colln.]; ♀, Plummer's Island, Md., June 8, 1914, at light (Schwarz and Shannon); ♀, Great Smokies National Park, 1,500 ft., Gatlinburg, Tenn., June 26, 1947 (R. H. Whittaker) [USNM].

From the holotypes alone, one could scarcely have arrived at the above synonymy, though it might have been suspected that *interruptus* was the clear-winged female of one of the others. Of the two species described from the male sex, however, there seemed to be a wide and obviously specific difference between the one with only a small black spot in the very tip of the marginal cell (*pseudostigma*) and the other with a large black spot covering the distal two-fifths of the marginal cell and the distal half or more of the submarginal cell, and extending into the distal portion of the apical cell (*flavidulus*).

The few individual specimens that were found from time to time did not clarify the situation for they were all females and were consequently identified as *interruptus*. However, the series of ten specimens, five of each sex, from Franklin, N. C., provides a whole range of variation that appears to link the three names together. All specimens show a considerable range in the color pattern on the thorax, from all reddish to reddish with three rather heavy black stripes. Of the five males, two have the wing pattern described for *pseudostigma*, two have a considerable area blackened in the submarginal cell though with the marginal clear, and one male has no infuscation in the wing at all. Another available male (Grosse Isle, Mich.) shows the full infuscation of *flavidulus*. Some specimens have a large oval black mesopleural spot, others a narrow and small one, others none. The second costal sector is unusually long in the males with the *pseudostigma* type of wing (3.5 to 4 times the length of third sector), quite short in the males with *flavidulus*-like wing (1.08 times the third sector, the second vein being quite short and strongly curved forward apically), and intermediate in most other specimens. All males have the same type of genitalia, relatively small for the genus, in side view high and narrow, black above but the rest yellow.

In view of the variability in these features but the similarity in fundamental structure and habitus, it is concluded that we are dealing here with one extremely variable species.

Commonly, especially in female specimens, the thoracic vittae are infuscated only posteriorly, and since the median vitta (or two, if it is divided) ends only slightly anterior to the lateral vittae, the resulting pattern is often a row of three (or four) black spots, sometimes small and round but more often elongate and tapering, across the mesonotum between the bases of the wings.

Apparently the narrow brown band on the hind tibia is a typical feature of the species, but the usual condition of such small flies often means that it is faint and inconspicuous.

21. **Gaurax mesopedalis,** new species

♂.—Species with considerable yellow, marked with black as follows: Occiput, posterior half to two-thirds of frontal triangle, mesonotum except for humeri and notopleura, meso- and pteropleuron predominantly, metanotum, abdomen, and middle leg except for the whitish distal fourth of the tibia; wing clear; male genitalia large, shining black.

Head slightly distorted, but the width of front at vertex apparently slightly over half the width of the head (.52-.54) and slightly greater than the length of the front (1.11-1.17); frontal triangle smooth and polished, short and broad, at the base occupying nearly the entire width of the vertex, but only .7 times the length of the front; third antennal segment reniform, relatively large (normal male character); notopleural bristles 1 + 1.

Holotype male: Kentucky Ridge State Forest, Kentucky, 1,200 ft., June 11, 1947 (R. H. Whittaker). *Paratype male:* Great Smokies National Park, 3,100 ft., Gatlinburg, Tenn., June 25, 1947 (Whittaker). U. S. National Museum Type No. 59297.

One female, Gatlinburg, Tenn., 4,000 ft., July 13, 1947 (Whittaker), is almost certainly this species, but the characteristic middle legs are broken off and the specimen is not included in the type series.

The color pattern of the legs, with pale yellow fore and hind legs and nearly all black middle legs, is unique in the genus.

22. **Gaurax atripalpus,** new species

♂, ♀.—Predominantly yellow, marked with black as follows: Arista, palpus, ocellar tubercle, occiput, mesonotal spot as figured (fig. 8), sides of scutellum at base, lower margin of mesopleuron, and metanotum; abdomen brown on distal three segments and sides of second segment; wing of male typically with some irregular infuscation between second and third veins at level of outer crossvein, and faint markings between the third and fourth veins (fig. 12); male genitalia yellow.

Head more or less collapsed in all specimens and the proportions cannot be stated; antenna not larger in male than in female; notopleural bristles 1 + 1, the upper posterior represented by a short, weak hair.

Holotype male, allotype, and four *paratypes* (3 ♂♂, 1 ♀): Oakland County, Michigan, May 21, 1947 (Bruce Summerville, reared from fungus). U. S. National Museum Type No. 59298, deposited through the courtesy of the collector; one paratype each in Sabrosky and Steyskal collections.

The type series was reared from a "large, polyporous bracket fungus" which contained considerable frass and sediment, probably from damage by beetles, for the collector reported emergence from the same fungus of about a thousand specimens of *Dorcatoma setulosum* Lec., *D. dresdensis* Herbst, and *Ennearthron* sp. The exact feeding habits of the fly larvae were not determined, but many chloropids are known to feed in the frass and burrows of other insects, and it seems probable that such is the case here.

The mesonotal pattern is somewhat reminiscent of that in *G. dorsalis,* but the black palpi and partially yellow scutellum will easily separate *atripalpus* from that common species.

23. GAURAX DUBIUS (Macq.) (=G. ephippium Zett.)

Oscinis dubia Macquart, 1835, Hist. nat. Ins., Dipt., II, p. 604 (France). *Oscinis Ephippium* Zetterstedt, 1848, Dipt. Scand., VII, p. 2664 (Sweden). *Gaurax ephippium* (Zett.) Becker, 1910, Archivum Zoologicum 1: 115 (redescription of Zetterstedt's type); Malloch, 1915, Ent. Soc. Wash. Proc. 17: 160 (N. H., in key); Malloch, 1915, Ill. State Lab. Nat. Hist. Bul. 11: 361 (N. H., in key); Johnson, 1925, List of Diptera of New England, Boston Soc. Nat. Hist., Occas. Papers 7: 278 (Maine, N. H., Vt., Mass.); Johnson, 1927, Biol. Survey Mt. Desert Region, Pt. 1, p. 223 (Maine); Proctor, 1938, Biol. Survey Mt. Desert Region, Pt. 6 (Insects), p. 350 (Maine); Proctor, 1946, op. cit., Pt. 7, p. 405 (Maine). *Botanobia dubia* (Macq.) (= *Gaurax ephippium* Zett.) Duda, 1933, *in* Lindner's Fliegen Palaeark. Region, Lfg. 68, pp. 80-81 (Austria, Germany, Finland); Collin, 1939, Ent. Monthly Mag. 75: 151 (England).

Predominantly yellow, marked with black as follows: Arista except basally, dorsal fourth to third of third antennal segment (often only browned), ocellar tubercle, dorsal two-thirds of occiput, large and posteriorly tridentate mesonotal spot (similar to fig. 7), narrow supraalar vittula (in some specimens), tiny spot just anterior to the foremost notopleural bristle, large oval spot along lower margin of mesopleuron, smaller spot in anteroventral corner of pteropleuron, metanotum, and dorsum of abdomen except narrowly at base; face and cheeks whitish.

Front relatively broad, at the vertex slightly over half the width of the head and one and one-fourth times as broad as long; frontal triangle appearing approximately equilateral, extending about four-fifths the length of the front; cheek as in *dorsalis,* broader than usual in the genus, a trifle over half the breadth of the third antennal segment and one-fifth the height of an eye; notopleural bristles 1 + 1, the upper posterior represented by a weak, pale hair.

Specimens examined: 3 ♀♀, Franconia, N. H. (Mrs. A. T. Slosson); 2 ♀♀, White Mts., N. H. (Morrison) [USNM, all determined as *Gaurax ephippium* by Coquillett].

One male, Bilby, Alberta, July 1, 1924 (O. Bryant) [Malloch Colln.] may belong here. It has the third antennal segment entirely whitish yellow, and the mesonotum is somewhat more broadly infuscated, the prescutellar

yellow areas appearing only as roundish spots on either side of a broad median black area. The wing is clear.

The species, from the mesonotal pattern, breadth of the cheek, and general habitus, might easily be confused with *G. dorsalis* if one neglected to note the color of the scutellum.

Unfortunately, I do not have European material of typical *dubius* before me for study of its relations to the Nearctic species. Five specimens (2 ♂ ♂, 3 ♀♀) sent to me as *Botanobia dubia* by Dr. O. Duda, the latest monographer of the Palaearctic Chloropidae, are really *Gaurax fascipes* Becker (Duda regarded *fascipes* as a synonym or color variety of *dubia,* but I agree with Collin, 1939, op. cit., p. 151, that the two are distinct). *Fascipes* is unquestionably distinct from any American species now before me; whether *dubius* will prove to be is a question that cannot be answered at the moment. However, inasmuch as the American species that has always been called *dubius* (as its synonym *ephippium*) agrees in all particulars with the very detailed description by Duda, and is extremely close to the European specimens of *fascipes* that are available, I have recorded it as *Gaurax dubius.*

The name *dubius* is new to the American literature for all records in this country have appeared as *Gaurax ephippium* Zetterstedt. Becker (1910), who redescribed Zetterstedt's type, thought that it was probably a synonym of Macquart's species. Recent European students of the Chloropidae have accepted the two as synonyms, and I have followed the same course.

A few specimens recorded as *ephippium* are here referred to *G. melanotum* (see following species). The specimen from Beulah, N. M. recorded as "*Gaurax epphippium* Zett.?" by Skinner (1903, Amer. Ent. Soc. Trans. 29:106), on the authority of Coquillett, has been examined in the collection at the Academy of Natural Sciences and is really a species of *Dicraeus,* another genus of the same family.

24. **Gaurax melanotum,** new species

♂, ♀.—Predominantly yellow, marked with black as follows: Arista except basal third, third antennal segment at least in part, ocellar tubercle, dorsal third to half of occiput, mesonotum up to the humeral and postalar calli and notopleura, metanotum, and abdomen; wing clear; male genitalia large and knoblike, shining yellow.

Width of front at the vertex .50-.54 times the width of the head and .94-1.10 times the length of the front, slightly broader in the females than in the males; frontal triangle rather short, about three-fifths the length of the front; long axis of eye diagonal; cheek broad for the genus, slightly over three-fifths the breadth of the third antennal segment and about one-fifth the height of an eye; notopleural bristles 1 + 1, the upper posterior represented by a pale hair about half as long as the lower bristle.

Holotype male: Lafayette, Ind., July 15, 1916 (J. M. Aldrich). U. S. National Museum Type No. 59299. *Allotype:* same locality and collector, Aug. 24, 1916 [USNM]. *Paratypes:* ♂, same data as type; 2 ♀ ♀, Franconia, N. H. (Mrs. Slosson) and Weston, Mass., July 23, 1911, [USNM]; ♀, Bennington, Vt., June 19, 1915 (C. W.

Johnson) [MCZ]; ♀, White Heath, Ill., June 3, 1917 [INHS]; ♀, Grand Bend, Ontario, July 12, 1939 (G. E. Shewell) [CNC].

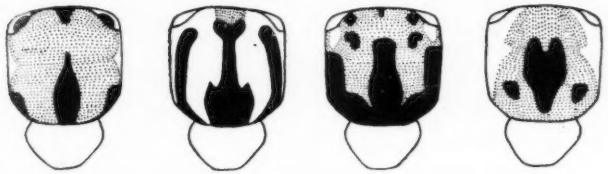
The New England specimens, both here and those recorded below as a variety, were determined by C. W. Johnson as *G. ephippium* and undoubtedly formed part of the record published for that species by Johnson (1925, op. cit.).

It is not impossible that *melanotum* is an extreme variation of *dubius* (*ephippium*). However, the consistent combination of black mesonotum with unspotted pleuron, coupled with unusually large and knoblike, bright yellow male genitalia, indicate a separate species.

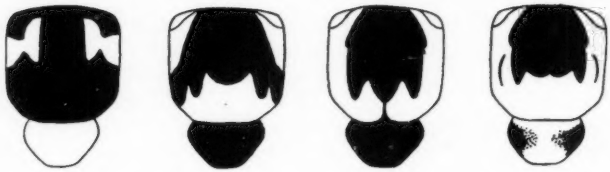
24a. GAURAX MELANOTUM var.

Three specimens differ in having the occiput yellow and the mesonotum black only posterior to the transverse suture, the black area thus appearing as a large subquadrate spot. However, these specimens are somewhat teneral, and tendencies toward a reduction in the extent of color are to be seen in the type series of typical *melanotum*. It seems probable, therefore, that these specimens represent only an extreme variation of that species.

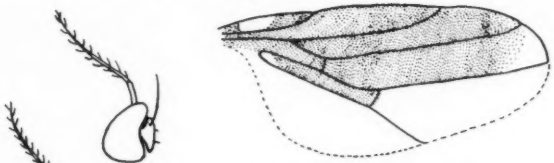
Specimens examined: ♂, Norwich, Vt., July 8, 1908 (C. W. Johnson [Sabrosky Colln.]; ♀, Bar Harbor, Maine, Aug. 2, 1910 (C. W. Johnson) [MCZ]; ♂, Grosse Isle, Wayne County, Mich., June 20, 1948 (George Steyskal) [Steyskal Colln.].



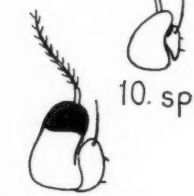
1. basitarsalis 2. festivus 3. splendidus 4. tripus



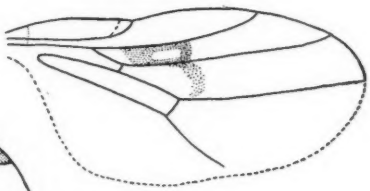
5. semivittatus 6. dorsalis 7. dorsalis var. 8. atripalpus



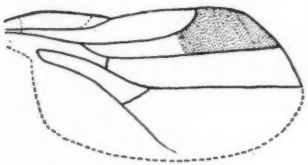
10. splendidus 11. splendidus



9. festivus



12. atripalpus



13. pseudostigma

Figs. 1-8, dorsal aspect of mesonotum and scutellum; figs. 9-10, lateral aspect of antenna; figs. 11-13, wing.

Note on the Method of Colony Foundation of the Ponerine Ant Amblyopone australis Erichson

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The method of colony foundation among ants is of peculiar interest to the student of phylogeny and social evolution in the Formicidae. Alone among the Aculeates, the Formicidae constitute a group all the members of which are social in character and have no immediately obvious affiliations with solitary forms, save for evident general affinities with such solitary Vespoid groups as the Scoliidae, the Thynnidae, the Mutillidae, and the Myrmosidae. The brief period of colony foundation, therefore, when the fertile females of many ants undergo a more or less prolonged period of solitary existence, becomes of peculiar significance as possible evidence, through recapitulation, of the manner in which social life arose and evolved in the Formicidae.

Such methods of colony formation show the widest variation among different groups, ranging from the well-known fully claustral type of the queens of many Formicine and Myrmicine ants on the one hand, showing its highest evolution in such a genus as *Atta*, to what might be called "colonial splitting" behavior in the Dorylinae on the other, where, for example, the wingless, dicthadiigyne females of certain species of *Eciton* are regularly sought out in the parental colony by the actively flying males, as Schneirla has shown (1948). There are scarcely two species of ants which exhibit identical behavior patterns of mating flight and of colony foundation. Considering the extraordinary importance of the process of colony foundation for our understanding of the social mode among the Formicidae, these richly varied patterns of behavior are deserving of study in some detail.

Of particular interest in this connection are the patterns of mating and of colony foundation among the Ponerinae, with little doubt the most generalized and in many respects the socially least evolved of all ants. It is reasonable to expect that in their mating behavior and in their method of initiating colonial life, as in other aspects of structure, physiology, and behavior, the Ponerinae may represent the closest living approximation to the ancestral stirp of the Formicidae.

It is noteworthy that, while the method of colony foundation among many of the higher ants can readily be observed in the artificial nest, and hence has long been well-known, this process is much more difficult to observe successfully among the Ponerines. The Ponerinae are far less plastic in their social behavior than are the higher ants, and it is less easy to secure normal behavior-patterns of colony foundation under circumstances where these can be fully observed and recorded. This situation may well account for the relative paucity of our knowledge of such behavior in the Ponerinae. Wheeler (1900a, 1900b), has published extensive observations on a number of American Poner-

ine species, including *Ponera pennsylvanica, Stigmatomma pallipes, Pachycondyla montezumiae, Leptogenys elongata,* and *Odontomachus clarus.* Of special interest in this connection are the studies of Clark (1925, 1934a) and of Wheeler (1932, 1933) on the method of colony foundation of three exceedingly archaic Ponerine genera of Australian ants, *Myrmecia, Promyrmecia,* and *Amblyopone.* Clark detected a curious and significant mode of colony formation in these genera, involving a process through which the young queen, after fertilization and dealation, isolated herself in a cell from which, however, she periodically emerged from time to time to forage for nectar and for insect prey for the developing larvae. Wheeler, in a brilliant study of *Myrmecia, Promyrmecia,* and *Amblyopone,* affirmed these findings of Clark through field observation, and elaborated the significance of the "partially claustral" behavior of the queens of these species. Clark has made numerous observations in the artificial nest, but these have not, so far as we are aware, been published in detail. Wheeler was obliged to confine his observations to the field.

This concept of a "partially claustral" method of colony foundation is of particular importance, for, if confirmed among a considerable number of the Ponerinae, it may be possible to reconstruct a rather probable picture of the mode of origin of ant societies. Haskins (1930) and Haskins and Enzmann (1938) have recorded observations of colony foundation in *Odontomachus haematoda* and *insularis, Paraponera clavata, Pachycondyla harpax, Euponera* (*Trachymesopus*) *stigma,* and *Proceratium croceum* which point in the direction of the "partially claustral" method of colony foundation as the normal one among those species. Haskins (1941) has demonstrated this situation in the African Ponerine species *Bothroponera soror* under artificial conditions. Recently it has been possible for Haskins and Haskins (1950) to confirm the findings of Clark in detail in the artificial nest for several species of *Myrmecia* and *Promyrmecia,* fully confirming also the picture of the "partially claustral" method in those genera as postulated by Wheeler on the basis of field observations.

The present paper is concerned with the method of colony foundation in *Amblyopone australis,* representative of the second great group of archaic Australian Ponerines in which Clark and Wheeler believed the "partially claustral" method of colony foundation to be the rule. The study is based upon three years of observation of the behavior of *A. australis* in the artificial nest, coupled with four months of field work spanning most of an Australian summer and including observations of the species in Queensland, New South Wales, Victoria, West Australia, and in the north island of New Zealand. The work was undertaken against a background of some twenty-five years of observation of the related American form *Stigmatomma pallipes* in the field and in the artificial nest.

Background

Amblyopone australis is an exceedingly primitive and generalized Ponerine ant of largely subterranean habit which, despite its archaic character, remains rather abundant over much of the Australian continent from Queensland around the coast to West Australia. It also occurs further inland where mois-

ture conditions are suitable. Closely related forms occur in New Zealand, New Caledonia, Lord Howe Island, Norfolk Island, New Guinea, and probably in adjacent land-masses.

A. australis, though neither a large nor a conspicuous species, is perhaps the most striking representative of the Amblyoponini, a remarkable tribe of exceedingly ancient forms, probably including, with *Myrmecia* and *Promyrmecia*, relicts of a once presumably cosmopolitan Cretaceous ant fauna. Though the Myrmecini are now confined to the Australian land mass and immediately adjacent islands, the Amblyoponini are more wide-ranging. In Australia and the adjacent islands they include numerous species of *Amblyopone* and representatives of the allied genera or subgenera *Lithomyrmex*, *Onychomyrmex*, *Xymmer*, and *Fulakora*, which have been extensively described by Clark (1925, 1928, 1934b, 1934c, 1938). In various parts of the southern Asiatic land mass, in the Papuan regions, or in Madagascar, the tribe is represented by the quaint genera *Mystrium*, *Myopopone*, or *Prionopelta*. In the New World it includes several species of *Stigmatomma*, the best-known of which is probably *Stigmatomma pallipes*, widely but sparsely and locally distributed over the North American continent.[1]

The Amblyoponini are usually confined to more or less moist regions, and all of them are somewhat subterranean in habit, many, such as *Stigmatomma pallipes* in North America, being probably completely hypogeaic except at the time of emergence of the sexual forms. *Amblyopone australis* is less subterranean than many members of its tribe, sometimes foraging above ground on dark days and under natural conditions, and frequently emerging from the artificial nest, about the entrances of which it may construct more or less elaborate craters of moist earth, punctured by the entrances to galleries. Characteristically, the adults of *A. australis* are rather highly specialized for terrestrial existence. The eyes are much reduced and the structure of the antennae, the legs, and the relatively generalized body admirably fit it to life in the tortuous galleries and the often narrow and tenuous chambers which constitute the typical nest of the species. The colonies are commonly of limited size, but may become rather large, probably including in some cases well over 1000, and possibly 2000, workers. The females are distinctly larger than the workers, and the latter exhibit some variation in stature, being smallest, ordinarily, in newly formed nests.

The adults of *Amblyopone australis*, like those of *Stigmatomma pallipes*, seem totally incapable of distributing ingluvial food either to one another or to the brood. No indication of regurgitation has been seen in the course of the present work with *A. australis* or in the course of much previous observation of *S. pallipes*. As with *S. pallipes*, the adult females of *A. australis* are purely entomophagous in feeding habits. Nectarivorous substances are not recognized as edible. The larvae are fed entirely on the partially dismembered

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1 Recently Brown (1949, and unpublished communication) has presented cogent reasons for suspecting that *Stigmatomma*, *Xymmer*, and *Fulakora*, and perhaps even *Mystrium* and *Myopopone*, are synonymous with *Amblyopone*.

bodies of insects, Myriopods, and other Arthropods normally captured underground, paralyzed or killed with the sting, and dragged to the brood-chamber. The larvae, as in *Stigmatomma,* are active and athletic and frequently attack and even kill and devour one another if other provender is scarce. Occasionally they may attack the adult nurses, as in *Stigmatomma.*

NUPTIAL FLIGHT

No observations, to our knowledge, have been published on the nuptial flight of *Amblyopone australis.* It was not possible to observe a natural flight in the course of the present study, but a facsimile of such a flight was secured artificially which appeared to present a reasonably faithful picture of the normal process. Earth-filled nests containing colonies of *A. australis* taken at Ferntree Gully, near Melbourne, Victoria in February, 1948, when sexual pupae were in the nest, shortly produced a number of young winged males and females. These nests were returned to the site of capture early on the morning of February 18, when it was noticed that the sexual forms had become restless, and were opened. By mid-morning all the males had emerged from the nests, had taken active flight, and had disappeared. The females followed somewhat later, emerging more slowly and with greater caution. Unlike the males, they did not fly immediately. Only after running about on the surface of the soil with buzzing wings for some time did they gradually and hesitatingly take flight. In the majority of cases they traveled but short distances, alighting rather quickly in low shrubbery. Here they became quiet, raising and folding the wings at intervals, extending and arching the gaster and rubbing it with the hind legs. This pose was maintained for a matter of minutes, after which the females again took short flights, alighted, and repeated the performance. No males appeared, but the general picture was so clearly similar to that described for young females of *Stigmatomma pallipes* similarly released from the artificial nest (Haskins, 1928), which were shortly fertilized by numbers of wild, low-flying males, as to leave no doubt that this pattern obtains also in *A. australis.* The queen may fly more actively and travel a greater distance than in *S. pallipes,* but it seems probable that the flight is not an extensive or sustained affair and that fertilization probably occurs commonly if not always on the ground or on low herbage.

BEHAVIOR AFTER NUPTIAL FLIGHT—COLONY FOUNDATION—ROLE OF QUEEN IN INCIPIENT AND OLDER COLONIES

The behavior of the female immediately after flight and fertilization appears to be somewhat variable. The most typical (and probably the most primitive and generalized) behavior-pattern appears to be to re-enter the soil very shortly and to construct a cell which is closed to the outside world, except as the queen reopens it from time to time to forage abroad for sustenance in the manner assumed by Wheeler. Thus a young infertile female of *A. australis* hatched in a colony taken by Mr. John Clark at Ferntree Gully, near Melbourne, Victoria, and most kindly sent to the authors, behaved in exactly this fashion in the artificial nest. After dealation, the female constructed a

closed cell, which was periodically opened as the insect emerged to take living prey, and in which a group of eggs was deposited, was formed into a packet and was carefully tended. Four infertile females taken at Ferntree Gully in February, 1948 (sisters or contemporaries of those used in the "artificial flight" experiments described above) all isolated themselves after dealation in Lubbock nests, where they constructed rather rambling series of galleries which were extensive and interconnected and were focused in a central cell in which the queens spent most of their time when not prowling in search of prey. These cells were not regularly closed, as is typical with young females of many species of *Myrmecia*, but were often left open for long periods, even when occupied. All of these infertile females produced eggs, formed them into packets, and tended them carefully, giving every evidence of a well-developed instinct of colony foundation. None of them, however, was able to bring its brood to maturity.

Though it was clear from these observations, and from more extensive and complete ones to follow, that the young queens of *Amblyopone australis*, like those of *Myrmecia* and *Promyrmecia*, can and frequently if not usually do isolate themselves after flight, construct cells, and rear their young, foraging periodically during this time, the wholly entomophagous feeding habits of the adult *Amblyopone*, in contrast to the highly nectarivorous diet of *Myrmecia* and *Promyrmecia*, appear to result in some interesting divergencies of pattern between the two tribes. Since the *Amblyopone* female, in contrast to *Myrmecia*, actively hunts for insect prey, kills or paralyses it with the sting, and *returns to the brood chamber with it to feed, regardless of whether brood is yet present*, the need of the young female to emerge on foraging expeditions arises much less frequently than with *Myrmecia*. Thus a young isolated infertile female of *Amblyopone* which had captured and paralysed the larva of a Tenebrionid beetle in the soil of its large Lubbock nest returned with the prey to its brood chamber and remained there for approximately two weeks without being observed again to emerge to hunt—a resting period in the brood-chamber which would have been quite impossible for a nectar-feeding *Myrmecia*. There is also evidence that the powers of fasting of the queens of *Amblyopone australis* may be much greater than those of *Myrmecia*, possibly because of a more specialized development of abdominal fat-body. Thus a young queen from which food was experimentally withheld after it had isolated itself and constructed its chamber persisted for eight months without nourishment (from the end of May, 1948 to the close of January, 1949) before finally leaving the nest and perishing. This is a power of fasting comparable with that of the queens of many higher ants. Whether the wing-musculature contributed to this situation remains to be determined.

It has been noted above that the infertile young females which were given an opportunity to isolate themselves after the flight period, in order to demonstrate this portion of the post-nuptial cycle, failed to establish colonies, although they exhibited a typical and uniform behavior pattern to the stage of the appearance of eggs and young larvae. The rest of this cycle has been

supplied from observations in the field and in the artificial nest on young fertile queens already naturally isolated when captured.

Wheeler (1933) recorded the finding of three isolated young fertile females of *Amblyopone australis foveolata* in cells under *Eucalyptus* logs at Margaret River, in southwestern West Australia. Two of these females were accompanied by young larvae and one by several nearly mature larvae and a few cocoons. An additional female was taken with nearly mature larvae and about twenty adult workers—probably a young colony in its second year. From these findings, Wheeler concluded that *A. australis* follows essentially the same typically primitive pattern of many *Myrmecia* in its mode of colony foundation.

It was possible for the authors to confirm Wheeler's observations on *A. australis foveolata* in a locality close to that in which he worked, to extend them to Wheeler's variety *pallidens* of *A. australis* at Mt. Kosciusko, N.S.W., and to amplify them in the artificial nest.

Seventeen young isolated females of *A. australis foveolata* were taken in cells under logs or stones in karri and jarrah forest at Manjimup, W.A. (not far from Margaret River) on March 9 and 10, 1948. Somewhat more than half of these insects were without brood, or had at most a few eggs and one or two small larvae, and, it seemed obvious, had flown in January or February. The rest were accompanied by mature larvae, cocoons, and in several cases by small, more or less callow, workers evidently rather recently eclosed. It was thought (and subsequently confirmed) that these females had taken flight a year previously.

Due to unfavorable collecting conditions, a number of these females and their broods were lost after capture. Three of the "second year" group, however, and seven of the "first year" group, were successfully established in the artificial nest. All of them re-formed cells of the type which they had occupied on capture, and in the case of the second-year colonies these cells were kept constantly open. In all three of these second-year colonies, the parent females continued actively to assist the young workers in foraging—and, in fact, continued to be the most important single factors in the colonial economy long after the communities were well established. All of these colonies reared new larvae during the year after they were established in Lubbock nests.

Greater interest, however, attaches to the behavior of the seven young females which were unaccompanied by brood, or which had only eggs or very young larvae when captured. Individuals of this group differed with respect to the closure of the cells, some repeatedly blocking the cell entrance after it had been broken through on foraging trips, while others left the chamber open continuously. Without exception, however, all these females left the cells with relative frequency to course through the galleries, and occasionally emerged from the nests altogether for brief sojourns in the open. All of them discovered insect prey which was provided with considerable dexterity, seized and

Fig. 1.—Young isolated fertile female of *Amblyopone australis* in cell in artificial nest with first brood.

stung it, and dragged it to the brood-chamber regardless of whether young were or were not present, as was also true of the infertile females studied.

Amblyopone appears to be much more thoroughly adapted to moist soil conditions than are many species of *Myrmecia*, and to be less susceptible to the attack of fungi. Correspondingly, discarded food fragments are removed from the brood chamber much less promptly and more casually than is the case with *Myrmecia*. Scraps of insect chitin, for example, often remained in the brood chamber of an *Amblyopone* queen for a week or longer, being more or less constantly licked. In the case of *Myrmecia* such fragments would be ejected in a few hours.

All seven of the *Amblyopone* queens shortly produced eggs which were formed into packets and constantly licked and tended. When larvae appeared, they also at first adhered in packets, and the licking was continued. The larvae were placed on or near food as it was brought in, but no striking changes in foraging habit on appearance of the larvae, such as are so typical of *Myrmecia*, were observed in *Amblyopone*. As the larvae developed, they were allowed to lie separately on the chamber floor, and they came to serve as an important food-source for the queens, which spent a good part of their time when not foraging in rasping and pinching the brood.

At maturity, the larvae were banked with earth by the females and spun their cocoons in typical Ponerine fashion, after which the earth particles were removed and the cleaned cocoons were stored in the driest part of the nest. At this stage of the life-cycle, however, an observational difficulty arose, due presumably to the reaction of this relatively non-plastic species to the unavoid-

ably somewhat artificial conditions of captivity. Without exception, the females showed a strong tendency to cut open the cocoons prematurely, and to extract and destroy the young worker pupae. Despite the fact, therefore, that many cocoons have been spun among the broods produced and tended by this group of young females, no young workers have yet survived to maturity.

That this situation is an artifact consequent upon observation, however, is rather conclusively indicated by the behavior of two other young fertile females of *A. australis* taken isolated under like conditions, on Mt. Kosciusko, in January, 1948. One of these queens was accompanied by a few first-brood larvae. The other was without young when taken. Both of these females behaved in most respects like those from Manjimup. Individual cells were formed, which were kept open to a network of subterranean galleries. Eggs were laid, and young larvae were reared on insect provender captured and brought into the chambers by the parents. Small cocoons were spun, as in the case of the females of *foveolata*. Neither of these females showed any tendency to destroy the brood, however, in sharp contrast to those from Manjimup, and small, callow, first-brood workers were eclosed in about a month. Four were produced in the first brood of one female, and one in that of the other. These individuals almost immediately joined their respective parent females in foraging, and, with this aid, so much insect material was brought into the nests that a large second brood was shortly reared. At this writing, this brood has attained maturity unmolested in one of the nests, and is approaching maturity in the other. As the population of the community increased, the extent of the galleries expanded markedly, and the original brood-chamber became somewhat smaller, due to the packing into it of earth excavated from the galleries. As there was small tendency to excavate new chambers (except for small ones at gallery junctions) the form of the nest changed quite decidedly after the first year from a relatively compact and centrally placed chamber with a few long radiating galleries to a complex, spiderlike mesh of passages with a few rather inconspicuous junctional enlargements. Since this seems to be the typical form of adult formicaries examined in the wild, it suggests that the nest structure normally attains its "adult" form (though by no means its full mature extent), under favorable conditions, sometime in the second year. Thenceforward it increases in total scope with the increase of population until it becomes, in some instances, a surprisingly extensive mesh of loosely-constructed, interweaving passages.

Throughout the entire period of observation of all these colonies, the females have continued actively in the hunting as well as in the reproductive function, showing little if any tendency toward the restriction of activity to specialized oviposition so characteristic of queens of the higher ants. Queens of *Amblyopone* in well established colonies have even continued to emerge from the nest into the open air from time to time.

Typical records of colony-foundation of several of these young first-year females, taken from Manjimup and from Mt. Kosciusko, are given below.

RECORDS OF COLONY-FOUNDING FEMALES OF A. AUSTRALIS

Nest No.	Locality and date of capture	Brood present at time of capture	Progress of new brood	Fate of brood
1	Manjimup, W.A., 3/10/48	None	4/13/48—4 eggs 4/28/48—9 eggs 5/ 5 /48—About 12 eggs 5/13/48—About 8 eggs 2 young larvae 5/21/48—4 eggs 4 larvae 6/25/48—8 eggs 3 larvae 8/17/48—2 cocoons	Cocoons destroyed, brood ultimately disappeared. Queen continuing to live isolated and to forage regularly.
2	Manjimup, W.A., 3/10/48	None	4/28/48—About 17 eggs 5/ 5 /48—About 10 eggs 4 larvae 5/13/48—6 eggs About 12 larvae 5/21/48—Same 5/31/48—Same 6/25/48—8 larvae 7/12/48—2 cocoons freshly spun 5 larvae 1 cocoon destroyed 7/15/48—3 larvae 2 cocoons destroyed 7/12/48—2 cocoons, freshly spun 5 larvae 1 cocoon destroyed 7/15/48—3 larvae 2 cocoons destroyed 7/21/48—1 cocoon 2 larvae 7/30/48—2 cocoons 1 larva	Cocoons destroyed, brood ultimately disappeared. Queen continuing to live isolated and to forage regularly.
3	Manjimup, W.A., 3/10/48	None	4/13/48—15 eggs 4/28/48—4 eggs 3 larvae 5/ 5 /48—5 larvae 6/25/48—2 larvae 2 cocoons 7/14/48—First cocoon destroyed 7/22/48—All remaining brood enclosed in cocoon and subsequently destroyed	Queen continuing to live isolated, and foraging actively.

Nest No.	Locality and date of capture	Brood present at time of capture	Progress of new brood	Fate of brood
*4	Mt. Kosciusko, N.S.W., 1/20/48	Several larvae	8/ 6 /48—8 larvae 1 cocoon, freshly spun 8/14/48—7 larvae 2 cocoons New egg packet 9/ 5 /48—3 cocoons 6 older larvae About 10 young larvae 9/16/48—1 cocoon hatched (small worker) 3 cocoons 5 older larvae About 6 young larvae 10/1/48—4 young workers 6 larvae 1/29/49—Cocoon, freshly spun 5 larvae 2/11/49—2 cocoons 4 larvae About 6 eggs	Colony flourishing.
**5	Mt. Kosciusko, N.S.W.,	None	4/11/48—6 eggs 5/ 9 /48—15 eggs 7/19/48—Eggs destroyed 2 new eggs 7/19/48—About 15 new eggs 9/ 5 /48—5 larvae 3/12/49—Old brood destroyed About 8 new eggs 4/ 1 /49—First larva hatched 5/ 7 /49—First cocoon spun 6/13/49—First cocoons hatched, eclosing small callow worker 6 larvae present	Colony flourishing.

* This example appears to be representative of the normal process.

** Probably an approximately normal pattern after March, 1949. The earlier "false starts" may have been occasioned by abnormal environmental conditions. It will be noticed that the larval period here was much shorter than in the case of the Manjimup queens. This may well be correlated with the short, hot summer and the long, rigorous winters at this elevation on Kosciusko. Though taken almost in the height of summer, snow had fallen but a few days before these females were collected.

It will be seen that the approximate periods of the egg, the larval, and the pupal instars in these examples (held throughout at 16-18°C.) were respectively one month, two to three months, and one and one-half months. These times, however, are very variable with temperature, with food supply, and with the trophic conditions within the nest. It is probable that they were shorter with these first-brood larvae, all of which matured as very small workers, than is the case among brood appearing later in the development of the colony and attaining to larger stature. Thus a relatively large larva in a second-year colony taken from Manjimup, which spun 126 days after it was collected, was not enclosed until 85 days after this, when it disclosed a full-sized, but rather pronouncedly callow, worker.

It may also be noted that, unlike *Myrmecia*, the eggs of *Amblyopone* are frequently devoured during the course of development and new ones laid in their places. As among the higher ants, therefore, but in rather sharp contrast to *Myrmecia*, the brood constitutes a potential source of food both to the first-brood larvae of *Amblyopone* and, probably, to the queen herself in case of emergency shortage of nourishment. In this respect, as in several other aspects of colony foundation, *Amblyopone australis* seems to follow a pattern somewhat intermediate between that of the Myrmecini on the one hand and that of higher ants on the other.

PLEOMETROSIS

In contrast to many of the Myrmecini but like several other species of the Amblyoponini, the colonies of *A. australis* are frequently, if not usually, pleometrotic. It seems clear that this pleometrosis is in some cases primary. This is indicated, for example, by Wheeler's finding (1933) of four young colony-founding females of *A. foveolata* associated in a single cell at Margaret River. That it may, however, also be secondary (caused by the return to the parent colony of young females fertilized in the near vicinity) is suggested by the behavior of young females hatching in two large colonies of *A. australis* under our observation. Both of these were taken from Ferntree Gully, Victoria. The first was most kindly collected by Mr. J. Clark and sent to the authors in December, 1946. At the time of its capture it contained several fine sexual cocoons, from which winged females emerged during the trip and after arrival. These females without exception eventually dealated themselves and returned to the parent colony. Here, though infertile, they laid numerous eggs from which large broods were reared by the young females and the older sister workers acting in cooperation. Eight of these queens have continued to live amicably in this colony for more than two years and to cooperate actively in colonial functions. There has been no hint of the rapidly developing hostility so prominent among young females of *Myrmecia* that return to the parent nest, or indeed among young females that rear their first broods in company, toward the end of the brood-rearing period. The second *Amblyopone* colony containing infertile females was collected in December, 1947, and has had essentially the same history.

This behavior strongly suggests the coexistence, in *A. australis*, of a pattern

of colony foundation which appears to be the dominant, if not the sole, one in *Stigmatomma pallipes*, in which young queens regularly seem to return to the parent or to neighboring colonies after fertilization, and in which the proliferation of colonies seems normally to occur through a process of splitting (Haskins, 1928).

SUMMARY AND CONCLUSIONS

The present observations of the method of formation of new colonies in *Amblyopone australis*, both in the field and in the artificial nest, taken in conjunction with the earlier observations of Clark, Wheeler, and others, seem to leave little doubt that the typical process is very closely similar in its essentials to the picture established for that other immensely archaic tribe among the Ponerinae, the Myrmecini. It seems evident that the young female of *A. australis*, after what is probably a more or less desultory flight and fertilization in the open, establishes itself in a cell in the ground which may be either blocked completely or may remain connected to a system of subterranean galleries, but is ordinarily closed off from the open air. Once this chamber is established, the queen emerges at irregular intervals to forage underground for Arthropod prey, which when captured is killed or paralyzed and dragged to the brood chamber for consumption, regardless of whether brood is yet present or not. The *Amblyopone* female may occasionally emerge above ground in the course of these expeditions, but probably does not do so often, in contrast to the *Myrmecia* female. Neither are the foraging trips of the *Amblyopone* female made as regularly or as frequently as are those of *Myrmecia*, dependent as the members of the latter genus are on nectar. Nor is any shift of feeding habits observable in *Amblyopone* when larvae appear in the nest, as is true of *Myrmecia*. When larvae appear, they are fed on fragments of insects and other Arthropods until maturity, when the larvae are banked, spin their cocoons, and are stored. They escape from their cocoons possibly completely independently, possibly with some aid from the adult female. Worker cocoons of *A. australis*, when isolated from the nest, invariably hatched successfully without aid, in contrast to the situation known for any other ants, even including the Myrmecini. The adult female continues to forage actively with the young workers and to feed the brood long after the former have matured, like the females of *Myrmecia* but in marked contrast to the behavior of higher ants, and may well continue this activity throughout the life of the colony.

Colonies of *Amblyopone australis*, unlike those of many if not most species of *Myrmecia* and *Promyrmecia*, are highly pleometrotic. There is evidence that this pleometrosis may sometimes be primary, occurring as the result of a permanent association of several colony-founding females. It seems probable, however, that it may also sometimes be secondary in character. Young fertile females may sometimes rejoin their own or other colonies, building up the reproductive strength of the unit and permitting it to proliferate by division. This appears to have become established as the normal behavior pattern in the American *Stigmatomma pallipes*, where the stature of the perfect females and the workers is much more nearly equal than it is in *Amblyopone*, and

where attempts to detect conclusive evidence of independent colony foundation by the female have been unsuccessful over twenty years.

There are thus considerable differences in the details of the progress of colony foundation between *Amblyopone australis* and the various species of *Myrmecia* which have been studied and reported on elsewhere. Such are the "fine structure" of the nuptial flight, the completeness of closure of the initial brood chamber by the queen, the foraging pattern and frequency of foraging trips, and the lack in *Amblyopone* of any pronounced shift of feeding habits concomitant with the appearance of the larvae, as is so characteristic of *Myrmecia*. These differences are primarily related to the greater specialization of *Amblyopone* to a subterranean habitat and to its purely entomophagous feeding habits, in contrast to the nectarivorous habits of *Myrmecia*. But in the major features, the colony-founding behavior of *Amblyopone australis* conforms strikingly to that of *Myrmecia*, and the patterns in both groups are in sharp contrast to those typical of the majority of higher ants.

Myrmecia and *Amblyopone* represent widely divergent groups of ants — more widely divergent in many respects than their differentiation as mere tribes of the Ponerinae might seem to imply. They have, in fact, relatively little immediately in common save the obviously immensely archaic nature of both groups, as unmistakably evidenced in many features of individual morphology and behavior, of distribution, and of colonial organization. The marked parallelism in the main features of the pattern of colony foundation to be observed in both groups, therefore, is strongly suggestive that this general pattern may represent an approximate recapitulation of the manner in which Formicid societies arose. It seems likely, in the present state of our knowledge, that the existent wealth and variety of Formicid social structures, with their tremendous range of variation from group to group, took their evolutionary beginnings in the activities of solitary, winged, ground-dwelling wasplike types in which the female, having dealated herself after fertilization, constructed a shelter in the ground and reared a small family to maturity. The larvae were provided with freshly killed prey captured and supplied through a behavior pattern intermediate in its complexity between the simple provisioning of paralyzed insects characteristic of the modern solitary Sphecoid wasps and the malaxated pellets of insects prepared for the larvae by their nurses in such primitive social Vespids as *Polistes*. Thus the hypothetical isolated pro-Formicid female built up a family of more or less retentive daughters, which in the course of evolution became increasingly differentiated from the mother, first, perhaps, in instincts and later, or contemporaneously, in morphology, until they finally became dependent entities and the colony structure was stabilized. The course of this social evolution may well have paralleled in striking fashion that which can be observed in the development of the social wasps and bees from solitary forms through contemporary living intermediate examples. In the ants, however, these solitary and intermediate forms appear to have been almost wholly lost. They are represented today only by the primitive tribes of the Ponerinae, in which the social mode is already well established, and a relatively high degree of specialization has already occurred. There can be little doubt that the social evolution of the Formicidae occurred

independently of that of the other social Aculeates, and at a point probably much more remote in time.

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The American Cyprinid Fish Notropis germanus Hay Interpreted as an Intergeneric Hybrid[1]

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The systematization of our knowledge of the immense fresh-water fish fauna of eastern North America is being advanced not only by the discovery of new forms and the reclassification of previously known species, but also by the elimination from the system of nominal species known only from the original accounts. Some particularly troublesome forms are eliminated through being interpreted as interspecific hybrids, as was done when Raney (1940) demonstrated that *Rhinichthys bowersi* Evermann and Goldsborough was based on a hybrid between *Rhinichthys cataractae* (Valenciennes) and *Nocomis micropogon* (Cope). Such action, when taken on reliable grounds, not only clarifies the systematics, but also contributes to the rapidly growing body of facts and interpretations regarding hybridization in nature between fish species. The present study clears the nominal species *Notropis germanus* Hay (1887: 252-253) from the system and adds a new interspecific hybrid, *Hybognathus hankinsoni* × *Notropis heterolepis*. A somewhat similar combination, *H. placita* × *N. girardi*, has just been recorded by Cross (1950: 128, 141).

A nomenclatorial complexity may arise from the circumstance that *Notropis germanus* was proposed prior to the naming either of *Hybognathus hankinsoni* Hubbs (in Jordan, 1929: 88) or of the still unnamed southern subspecies of *Notropis heterolepis* Eigenmann and Eigenmann that is characterized by the complete or nearly complete lateral line and that may be involved in the hybrid combination. There is apparently no rule or recommendation in regard to the availability of a name regularly proposed for a nominal species that is later interpreted as an interspecific hybrid. It might be argued that the name was based on a complex and should be associated with the element of the complex to be selected by the first author who recognizes the situation and unequivocally makes the selection. Such action has been taken in respect to names based on subspecific intergrades and the distinction between these and interspecific hybrids is often subjective and tenuous (Hubbs, 1943). On the other hand, names based on interspecific hybrids are not applicable to true populations and the type specimens would not be representative. More doubt, confusion and instability would arise from accepting than from rejecting names interpreted as based on interspecific hybrids. It is therefore recommended that these names be regarded as unavailable for either parental species. Such apparently has been the practice in both botany and zoology.

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1 Contributions from the Scripps Institution of Oceanography, New Series, No. 502.

HISTORY OF THE NOMINAL SPECIES

Notropis germanus was described by Hay (1887: 252-253), with stated trepidation, on the basis of a single specimen (U.S.N.M. No. 37949) that he had collected in Smoky Hill River, in the Missouri River system, at Wallace, near the Colorado border in Kansas. Meek (1894: 136) misidentified the poorly preserved specimen with the very different northern species *Notropis heterodon* (Cope). This error was obviously the basis for the inclusion of Kansas within the range of *N. heterodon* in all editions of Jordan's Manual of the Vertebrates from the 5th (1888: 55) to the 12th (1916: 55) and in subsequent manuals, whether using the name *Notropis heterodon* (Pratt, 1923: 77) or that of *Hybopsis heterodon* (Pratt, 1935: 74; Schrenkeisen, 1938: 135-136; Driver, 1942: 274). Jordan and Evermann (1896: 261) and Evermann and Cox (1896: 369, 402, 425) also included *N. germanus* in the synonymy of *N. heterodon* and the error was repeated by Jordan, Evermann and Clark (1930: 136), under the name *Hybopsis heterodon*. By the elimination of Kansas from the stated range of *Hybopsis heterodon* (Jordan, 1929: 79) and of *Notropis heterodon* (Hubbs and Lagler, 1941: 58; 1947: 66), *N. germanus* tacitly has been removed from the synonymy of *N. heterodon*. This rectification leaves the range of *N. heterodon* compact and consistent.

It is clear from the original description that Hay was uncertain as to the status of *N. germanus*. Since the type specimen, however, has some very distinctive characters, yet shows no signs of abnormality, and since he wrote before the critical and clarifying evaluation of natural hybrids, it was only natural that he should have named the form. He probably appreciated the intermediacy of some of the generic characters, for he said that "were the intestinal canal not so short—shorter than the body—the specimen might be referred to *Hybognathus* (*Dionda*) *nubila* Forbes" (*Dionda nubila* is rather intermediate between *Hybognathus* proper and *Notropis*, but has the intestine much more convoluted than it is in the type of *N. germanus*). The pharyngeal teeth, as described, are generically intermediate, though they were not so designated. Overemphasizing a partial similarity to *N. deliciosa*, Hay compared *N. germanus* only with that species.

IDENTIFICATION OF THE HYBRID

A brief study of the type specimen of *Notropis germanus* in May, 1933, convinced me that it was either an otherwise unrecognized species or, much more likely, a hybrid between *Hybognathus hankinsoni* and some species of *Notropis*. Perhaps swayed by Hay's alignment of his species with *N. deliciosa* and noting that the specimen approached *deliciosa* more closely than any of the other species taken by Hay at the same locality, I provisionally interpreted it as a hybrid between *Hybognathus hankinsoni* Hubbs and *Notropis deliciosa missuriensis* (Cope). This view was published by Breukelman (1940: 374). The soft and faded condition of the specimen hindered precise determination.

A more penetrating analysis of the characters, on April 7, 1950, convinced me that the second parental species was not *N. deliciosa*, nor any other species

collected at the same locality, but almost certainly was *Notropis heterolepis*. Before entering into a discussion of the species involved, however, we should consider the presumed parental genera.

THE PARENTAL GENERA

The interpretation of an otherwise unidentifiable specimen as a natural hybrid between the long-intestined genus *Hybognathus* and the short-gutted group *Notropis* needs occasion no great surprise or doubt. On the basis of such criteria as were used in the interpretation of many catostomid fish as interspecific hybrids (Hubbs, Hubbs and Johnson, 1943: 11-14), convincing grounds have already been found for identifying a considerable number of cyprinid specimens as hybrids between *Hybognathus* and the closely related genus (or subgenus) *Dionda* on the one hand and *Notropis* and other short-intestined genera on the other hand. Among the dozens of interspecific combinations that have thus far been recognized among the Cyprinidae of eastern North America, chiefly on the basis of unpublished researches at the University of Michigan Museum of Zoology, are many that seem to involve parental genera less closely related than are *Hybognathus* and *Notropis*. Thus the very aberrant genus *Campostoma* appears to hybridize occasionally with such diverse groups (genera and subgenera) as *Nocomis, Rhinichthys, Semotilus, Clinostomus, Chrosomus, Luxilus* (subgenus of *Notropis*), and *Dionda*. In the modern view that fish groups with a long gut were repeatedly evolved from others with a short gut (Hubbs and Turner, 1939: 17; Hubbs, 1941: 188), *Hybognathus* (with *Dionda*) has been interpreted as a recent offshoot from *Notropis* or an allied genus (Hubbs and Brown, 1929: 29). The older idea, that the long-intestined and short-intestined minnows belong to two distinct evolutionary lines, was already doubted by Jordan and Evermann (1896: 202-204) and has now been abandoned.

One parental species is identified as a *Hybognathus* and the other as a *Notropis* primarily on the basis of the structure of the intestine, the pharyngeal teeth, and the jaws.

The intestine describes 2 definite, not very tightly compacted S-shaped loops, one behind the other, as in no known species of cyprinid in eastern North America. In all the many and varied species of this region the intestine has either a single compressed S-loop or several to many coils. Only a hybrid could be expected to have such an intestine. Many characters exclude from consideration *Chrosomus, Pimephales* and *Campostoma*, the long-gutted genera other than *Hybognathus* to be expected in the region. On the basis of the intestinal convolution the other parental genus could have been any of the short-gutted genera of the area, but on the basis of other characters, that genus is inferred to have been *Notropis*. The apparently silvery peritoneum also suggests hybridization, for it is inconsistent with the somewhat elongated intestine. A blackening of the peritoneum in the Cyprinidae almost invariably accompanies a lengthening of the gut (Hubbs, 1941: 188).

The pharyngeal teeth correspond with the assumption that the parental species were a *Hybognathus* and a *Notropis*, each with a 4—4 tooth formula. The number is given in the original description as 4—4, with the statement

that the teeth have "a distinct masticatory surface" and that the first tooth is hooked. The left arch, which alone remains with the specimen, has characters that confirm the hybrid determination. The arch is thick and somewhat swollen, much as in *Hybognathus*, but the moderately broad slope below the teeth of the main row shows no trace of the attachment of small teeth. The 4 teeth of the main row have rather broad grinding surfaces, less well developed than in *Hybognathus* but better formed than in *Notropis*. Instead of lacking hooks, as in *Hybognathus*, or of being rather strongly hooked, as is typical in *Notropis*, the teeth in this regard are intermediate: the first and third teeth (from above) are rather weakly hooked, whereas the second and fourth lack hooks.

In the structure of the jaws, which resemble those of *Dionda nubila*, *N. germanus* definitely appears to be a *Hybognathus* × *Notropis* hybrid. The lower jaw is too slender for a *Notropis* and, like that of *Dionda* or *Hybognathus*, has a symphyseal knob. The mouth is only slightly oblique and is of moderate size: the length of the upper jaw enters the head length 4.3 times. The mouth is smaller than would be expected in a hybrid between *Hybognathus* and either *Nocomis* or *Semotilus*, and too large and too oblique for expectation in a *Hybognathus* × *Phenacobius* combination. Thus the short-gutted genera of the region other than *Notropis* (Breukelman, 1940: 370-371) seem to be eliminated from consideration.

THE PARENTAL SPECIES

Little doubt can be attached to the identification of the *Hybognathus* parent as *H. hankinsoni* Hubbs. As indicated by Breukelman (1940: 371) I have reidentified as *H. hankinsoni* the 2 specimens of this genus (U.S.N.M. No. 38237) that Hay took with the type of *Notropis germanus* and reported (1887: 253) as *H. nuchalis*. In the only moderately elevated and rounded, not at all falcate dorsal fin (depressed length 1.6 in distance to occiput and 2.6 in distance to tip of snout) and in the vertically oval scales with numerous radii, the type of *N. germanus* definitely resembles *H. hankinsoni* as contrasted with *H. nuchalis* (Hubbs and Lagler, 1941: 50; 1947: 58) or with *H. placita*.

Ordinarily one finds both parental species of a natural hybrid among species associated in the same collection, and among these *N. deliciosa* best fits expectations. *N. topeka* would fit almost as well, but none of the other cyprinids listed by Hay from the same locality has characters that could plausibly be inferred to combine with those of *H. hankinsoni* to produce a fish resembling the type of *N. germanus*. These additional species are *Semotilus atromaculatus atromaculatus* (Mitchill), *Nocomis biguttatus* (Cope), *Phenacobius mirabilis* (Girard), *Notropis cornuta frontalis* (Agassiz) ("*megalops*"), and *Notropis lutrensis lutrensis* (Baird and Girard). *N. lutrensis* was listed twice, once perhaps by error for another species.

The fin-ray formula (D 8, A 9, C 10+9, P_1 13—13, P_2 8—8) is not obviously significant except for the number of anal rays. The characteristic number in the species most plausibly involved is 8 for *Hybognathus hankinsoni* and *Notropis heterolepis* and 7 for *Notropis deliciosa* and *N. topeka*. Since

in ray numbers hybrids are almost invariably intermediate between the parental species, *N. deliciosa* and *N. topeka* are almost surely eliminated. Furthermore, the anal rays in the hybrid are fine and delicate, not approaching in strength and thickness the rays of *N. deliciosa* and *N. topeka*. It would be plausible to assume that the parental species other than *H. hankinsoni* has 9 or more anal rays, but the only species known from northwestern Kansas (Breukelman, 1940: 370) that normally have more than 8 anal rays, namely *Notropis cornuta frontalis* (Agassiz) and *N. lutrensis lutrensis* (Baird and Girard), both seem to be excluded from consideration by reason of their deep bodies and numerous other characters that are not suggested by the hybrid, in which the depth of the body is only one-fifth the standard length. Additional species with 9 or more anal rays that conceivably might have occurred in Smoky Hill River have other characters that would almost certainly not combine with those of *H. hankinsoni* to produce a fish like "*N. germanus.*" Since the hybridity of this "species" seems almost certain, we are forced to infer that the *Notropis* parent had 8 anal rays, as does *N. heterolepis*. The anal rays in the type are unusually fine and crowded, especially toward the posterior end of the fin, as they usually are in specimens of any species that have an abnormally high ray count.

The tooth formula (4—4) of the hybrid favors a like formula in the *Notropis* parental species, but would not certainly exclude one with a 1, 4—4, 1 tooth formula. *N. heterolepis, N. deliciosa* and *N. topeka* all have the formula 4—4.

The squamation is significant, though the standard formula as given by Hay (5—35 or 36—4) is not very critical (I counted 34 scales in the lateral line series, but the scales are now largely destroyed). The number of scales around the caudal peduncle seems much more meaningful. These number only 12, with 5 above and 5 below the lateral line. In *H. hankinsoni* and in *N. deliciosa missuriensis* and *N. topeka*, all from northwestern Kansas, I count 15 or 16 scales around the peduncle. It is certainly not to be expected that 12 peduncular scales would ensue from the crossing of 2 species, each with 15 or 16 scales. *N. heterolepis* has 12 scales around the peduncle and thus again fits expectation much better than do the other species named.

In its slender body (depth about 5.0 in standard length) and especially in the slender, protracted form of the caudal peduncle, the hybrid also resembles *N. heterolepis* much more than *N. deliciosa missuriensis* (a chunky subspecies) or *N. topeka* (a robust species). The least depth of the peduncle enters the head length 2.7 times and the peduncle length 2.6 times.

The rather flat upper contour of the head and the slenderness of the head (depth 1.7 in length) further point toward *N. heterolepis* and away from *N. deliciosa missuriensis* and *N. topeka*. Other proportions, such as the size of the eye (corneal length 4.0 in head), the length of the upper jaw (4.3 in head), the broad head, and the position of the dorsal fin (its origin more than a pupil's length nearer tip of snout than base of caudal), agree with calculated expectation for a hybrid between *Hybognathus hankinsoni* and *Notropis heterolepis*. A hybrid with either *N. d. missuriensis* or *N. topeka* would probably have a smaller eye.

In coloration also the type of *N. germanus* is more suggestive of *N. heterolepis* than of *N. d. missuriensis* or *N. topeka* (*Hybognathus hankinsoni* is very uniformly pigmented). The lack of pigment on the chin is particularly significant and, of course, negates the identification of *N. germanus* with *N. heterodon*. Hay described the color as quite dark above, with broad dusky borders on all the scales. Traces remain of this color, though the scale-pocket borders seem to have been weak in a light streak above the dark lateral band (a diagnostic feature of *N. heterolepis*). The distinct dusky streak running through the silvery sides and the especially prominent dark streak on the snout and on the opercle, as described by Hay, duplicate just what would be expected in a *hankinsoni* × *heterolepis* hybrid. The black dots described as marking the lateral line pores suggest the coloration of *N. d. missuriensis* and *N. topeka*, but the faded remnants of these "dots" suggest that these markings were definitely larger and more prominent than in those species and approached the crescentic dark marks on the lateral-line scales of *N. heterolepis*. There is further agreement with or approach toward *N. heterolepis* in the prominence and large size of the melanophores on the top of the head, in the dark general coloration, and, especially, in the development of melanophores in the peritroct. This region in *N. heterolepis* as in *N. volucella* is punctulate, but in *N. deliciosa* is diagnostically devoid of black pigment (Hubbs and Lagler, 1947: 61). The basicaudal spot is not conspicuous.

Which subspecies of *Notropis heterolepis* was involved in the cross is perhaps indeterminate. The southern form scarcely differs from the nominal subspecies in any respect other than the complete or nearly complete lateral line, and few scales remain on the type of *N. germanus*. The very few in the axial series show no distinct pore and it is thought possible that *N. h. heterolepis* was the subspecies involved. That subspecies occurred in the headwaters of the South Platte River in Colorado (see below) and may have been the one that lived in the Smoky Hill River near the Colorado border of Kansas.

ZOOGEOGRAPHICAL AND ECOLOGICAL CONSIDERATIONS

It may be objected that one putative parental species, *N. heterolepis*, has never been reported from the Smoky Hill River or immediately adjacent waters and seems to be absent now throughout Kansas, but that situation has not always existed. This minnow is known to have occurred formerly south as well as north, and west as well as east of Smoky Hill River and it presumably also inhabited that stream. The species seems to have become greatly depleted and in most areas extirpated throughout the southern part of its range. A recent re-examination of the specimens shows that Jordan (1891: 18), under the name of *N. cayuga*, reported the southern subspecies of *N. heterolepis* to be common in the Arkansas River at Wichita, in southern Kansas. No other records or specimens from Kansas have been encountered by John Breukelman or by W. Ralph Taylor, in their studies of the fishes of this state. This subspecies, with some intergrades, was recorded as *N. cayuga* by Evermann and Cox (1896: 401) from numerous localities in Nebraska and adjacent states. The thorough surveys of Nebraska from 1939 to 1941 by Raymond E. Johnson (Doctoral Dissertation, University of Michigan, 1942) disclosed no evi-

dence of its continued existence in that state, save in one restricted region of northern relicts in the Sand Hills. From Colorado (Juday, 1904: 114; 1905: 227; Cockerell, 1908: 167, 169, 171; Ellis, 1914: 49) the species has been reported solely on the basis of specimens collected in 1903 in the South Platte system at Longmont. A specimen from Longmont in the National Museum is referable to the typical subspecies. Repeated tries in 1950 by William C. Beckman and staff to collect further specimens in the same region have failed. In Iowa, the species has become very scarce, if it survives at all (Reeve M. Bailey, personal communication; Harrison, 1949: 337). As elsewhere indicated (Hubbs, 1951), Forbes and Richardson (1909: 134), in part as *N. cayuga* and in part as *N. cayuga atrocaudalis*, reported the southern subspecies of *N. heterolepis* from several localities in central and southern Illinois, where the species is now extirpated or nearly so. This subspecies seems to remain common only in Missouri and even in that state is local and scattered. In the Museum of Zoology of the University of Michigan there is a single series of the same subspecies from Tennessee. In Indiana (Gerking, 1945: 65, map 49) the species is extremely rare, except in the glacial lakes, and in Ohio (Milton B. Trautman, personal communication) it is now extirpated over most of its primeval range.

The widespread depletion and general extirpation of *Notropis heterolepis* throughout the southern part of its range is attributable to the deterioration of the habitat. This is one of the minnows that prefers cool, clear, weedy waters (Hubbs and Lagler, 1941: 59-60; 1947: 68) and such primeval conditions, as a result of agricultural practices, have largely been eliminated south of the limits of Wisconsin glaciation.

That *Notropis heterolepis* may well have lived in the Smoky Hill River prior to the excessive cultivation of the Plains is suggested by the occurrence there in 1885 (Hay, 1887) of other species generally characteristic of cool, clear waters, such as *Nocomis biguttatus* (probably now extirpated there, according to Breukelman, 1940: 370), *Semotilus a. atromaculatus*, *Notropis cornuta frontalis* and *Hybognathus hankinsoni*.

It is inferred that *Notropis heterolepis* was on the road to extirpation in Smoky Hill River when Hay made his collections in 1885 and that the remnant was inclined to hybridize with other species. The tendency of a vanishing species to hybridize with others was suggested by Greene (1935: 87-89) in his discussion of *Clinostomus elongatus* in Wisconsin and Michigan. In general, it seems to be true that the scarcity of a fresh-water fish species, whether due to recent establishment or to impending extirpation, is especially conducive to hybridization with other species (Hubbs and Brown, 1929: 28, 36; Hubbs, Hubbs and Johnson, 1943: 39, 47-48, 63; Hubbs, Walker and Johnson, 1943: 4, 8-9, 15, 19-20; Hubbs and Hubbs, 1947: 151-154).

On distributional and ecological grounds it is plausible to assume that *Hybognathus hankinsoni* and *Notropis heterolepis* may hybridize. Both seem to prefer cool, weedy waters, chiefly in northern regions (Hubbs and Lagler, 1941: 59-60; 1947: 68). These species often occur together and may well have similar reproductive proclivities, in respect to season, habitat and behavior.

SUMMARY AND CONCLUSIONS

When nominal species that have complicated the system are reliably interpreted as interspecific hybrids a contribution is made not only to systematics but also to natural genetics. Names based on such hybrids are regarded as unavailable for either parental species. *"Notropis germanus,"* from Kansas, is interpreted as a hybrid, *Hybognathus hankinsoni* × *Notropis heterolepis*. Except in the number of anal rays (9), the characters of the type and only known specimen of *germanus* are consistent with this interpretation and the crowded anal rays suggest an abnormally high count. No other species that might have occurred in western Kansas, other than *N. heterolepis*, has characters that could be expected to combine with those of *H. hankinsoni*, which was clearly one parental species, to produce such an offspring. As usual, most characters of the hybrid are intermediate.

In view of the very extensive pattern of interspecific hybridization among American Cyprinidae, this determination occasions no great surprise, even though the inferred parental species are very unlike structurally. The differences are largely associated with nutrition and have less taxonomic weight than they were formerly thought to have.

It is assumed that *N. heterolepis* in the southern part of its range was already on the now nearly completed road to extermination, as the result of agricultural practices, when Hay collected the hybrid in 1885. In line with other observations, it is presumed that the scarcity of this species was conducive to its hybridization with other forms. This propensity may well accelerate the extirpation of species that have become rare through a deterioration of the environment.

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The Range of Cryptobranchus bishopi and Remarks on the Distribution of the Genus Cryptobranchus*

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Since the publication of the description of *Cryptobranchus bishopi* Grobman (1943: 6) with the statement that this form is restricted to tributary streams of the upper Black River system in south-central Missouri and north-central Arkansas, one new record has appeared that necessitates re-examination of the geographic range pattern of this species. Mention of a specimen of *Cryptobranchus bishopi* (Univ. Kansas Mus. No. 16143) from Greene Springs, Vernon County, Missouri, is made by Hall and Smith (1947) in their report of the surprising occurrence in Kansas of *Cryptobranchus alleganiensis* from the Neosho and Spring rivers of the Arkansas River system. These authors state further that despite the proximity of these localities in eastern Kansas and western Missouri, and the distant known records for *alleganiensis*, the Kansas specimens cannot be considered as assignable to *bishopi* but are tentatively regarded as typical *alleganiensis*.

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The appearance of *C. bishopi* in Vernon County, Missouri, seems problematical, since Greene Springs is located in the vicinity of the upper reaches of the Osage River tributaries (Clear Creek, Dry Wood Creek and Marmaton River), a part of the Missouri River drainage and well within the assignable range of *alleganiensis*. Grobman (*loc. cit.*, map, p. 7) records *alleganiensis* from a tributary of the Osage River and also in the adjacent Gasconade River. The admixture of two forms of *Cryptobranchus* within the same Missouri River system would lead one to suspect intergradation despite the fact that Grobman regarded *bishopi* as a full species. Upon careful examination and comparison of the "Vernon County" specimen with the paratype series I came to the conclusion that it is wholly typical of *bishopi* (the ratio between the diameter of the branchial opening and the internarial distance is 5:12). Suspicion was immediately focussed on the validity of the locality data. The Kansas University specimen was collected by B. C. Marshall (a professional collector who sold his specimens to various museums) at, according to the catalogue and jar label, Greene Springs, Vernon County, Missouri,

* Contribution from the Museum of Natural History of the University of Illinois, Urbana, Illinois.

on July 23, 1928. At the American Museum of Natural History Grobman's paratypes (A.M.N.H. nos. 23053-54) were examined and it was noted that these were also collected by Marshall July 23, 1928, at Greer Springs, Oregon County, Missouri. A further check of other specimens deposited at the American Museum by Marshall, disclosed that all the localities visited during the month of July centered in the Oregon County sector. Through the kindness of Dr. James Oliver, I was able to examine Marshall's itinerary for July, 1928, kept on file in the Department of Amphibians and Reptiles, American Museum. The exact collecting dates and localities were as follows: July 9, Lawrence County, Arkansas; July 12, Wright County, Missouri; July 13, Douglas County; July 14-15, Shannon County; July 23, Greer Springs, Oregon County; July 25, Greer, Oregon County. It seems fairly obvious therefore, that the Kansas University specimen is merely one of the same series designated as paratypes. It is unlikely that Marshall, at this time, made a journey to Vernon County, some 200 miles distant. I therefore suspect that the University of Kansas Museum locality is in error, and that during the process of transcription, "Greer" was misinterpreted as "Greene" and thus followed the designation of the specimen as Vernon County.

More recently another record of *bishopi* has come to light. This specimen (Univ. Kansas Mus. No. 27814) was collected in Spring Creek (a tributary of the White River), 19.7 miles WNW of West Plains, Douglas County, Missouri, by Dr. A. B. Leonard on August 22, 1948. It was first discovered under a rock in the swift flowing waters of the stream and although many other rocks in the vicinity were overturned, no other specimens were obtained. This individual measures 308 mm. from snout to vent. The branchial openings are typically reduced, 2.8 mm. in diameter on the right side and 5.0 mm. on the left, and thus well within the ascribed limits of *bishopi*. The body has the typical large blotches of this species.

The range of *C. bishopi* is now known to include Black River tributaries such as Current River, Greer Springs and Eleven Point River, and Spring Creek of the White River drainage system. Black and Dellinger (1938) reported *Cryptobranchus* from Spring River in Arkansas (Mammoth Spring, Fulton County), but no specimens are actually available. Dr. Dellinger told the author (in 1946) that several other specimens from this locality in the Black River system have come to his attention since that publication, and that they represent *bishopi*. The State Fish Hatchery at Mammoth Spring exhibit one or two examples occasionally, and fishermen in the area report having obtained the salamander on their lines. *C. bishopi* undoubtedly occurs in other streams in the central Missouri-Arkansas Ozark area. Fishermen claim that they are common in the upper Black River and possibly they may inhabit the St. Francis River which flows directly into the Mississippi River.

It is appropriate to remark upon the mode of speciation exemplified by the Cryptobranchidae. The family as a whole shows extreme conservatism, and there is little tendency toward the production of genotypic or phenotypic novel-

ties. The differences between *Cryptobranchus* and the Asiatic *Megalobatrachus* are minor and neither genus is very distinct from the fossil *Andrias scheuchzeri* from the Oligocene of Europe (Schmidt, 1946: 149). This group of derotreme salamanders shows little evidence of a phylogenetic sequence of differentiation. Rather, all morphological differences, *e.g.* the number of epibranchials on the hyobranchium and the closure of the branchial fenestrae, that form the bases for generic designations, rest on the level of metamorphosis attained.

Evidently, as Noble (1927, 1929) has shown, a very small genetic factor is responsible for this type of variation in metamorphosis. A desensitization of specific tissues to thyroid extracts (the metamorphosis-inducing endocrine hormone) has evolved, and if it were not for this small mutation, cryptobranchids could normally transform completely since the thyroid gland is functional. "Change" in this respect should not be considered as a phylogenetic shift of position. Thus it would be very difficult indeed to attempt to analyze the evolution of the cryptobranchids in the light of primitive-versus-modern components. It may be stated only in this fashion: *Megalobatrachus* is further along in total development toward adulthood than is *Cryptobranchus alleganiensis*, which is somewhat "retarded" and represents a lower stage in the ontogenetic development of the family. *C. bishopi* may be placed somewhere between these two extremes. The species composing the genus *Cryptobranchus* represent then, merely a reshuffling of evidently one genetically controlled factor; *bishopi* showing a definite "advancement" toward a completed metamorphosis because of the tendency toward the closure of the branchial fenestrae.

In the light of the above remarks it is doubtful if *C. bishopi* differentiated altogether by mere isolation and the consequential genetic shift and stabilization of characters. Rather, *bishopi* represents an attainment of a certain "stage" or "degree" in the ontogenetic development of the species as a whole. A mutation threshold in the developmental series is reached by the influence of internal factors (considering of course that external factors are here regarded as fairly constant in the phylogeny of the group) and this identical threshold of development theoretically may be crossed again and again (presumably from any direction) in the speciation of the group. This periodical recurrent mutational type from the same stock ("iteration" of Beurlen, 1929) may give rise to isochronous convergence. If this be possible then polyphyletic speciation may occur. Potentially the "*bishopi*" phenotype may erupt within any part of the range of the genus since this species represents only a functional stage of development. In this species, stabilization by genetic inheritance and perhaps the effect of environmental selection (although this last point is doubtful) enhances to a degree the maintenance of the "thyroid immunity." Such a physiological action manifested itself in profound morphological effects that formed the basis for the recognition of distinct species. This change is latent in every *Cryptobranchus* and merely needs "stimulus" for its expression.

To repeat the thesis explored above, it may be postulated in this case that

speciation and differentiation have been the result of change in the "reactivity" of tissues and its morphogenetic effect. The raising and the lowering of the threshold level of tissue sensitivity to thyroid hormone has resulted in arrested ontogenetic development and in complete metamorphosis. The adult of the theoretical ancestor may be pictured as a hynobiid salamander, probably of a swift-water habitus.

It is difficult to determine which of the species of *Cryptobranchus* represents the basal stock in North America. The point of contact between the two probably occurred in the Black River watershed. Previous to glaciation in North America, cryptobranchids evidently enjoyed a wide distribution. A fossil genus, *Plicognathus*, is known from the Lower Pliocene of Nebraska. With the advent of glaciation, the representatives of this family of salamanders withdrew to a specialized area in the unglaciated portion of the country, which presented optimum conditions for their existence. Two areas were available at this time: the Ozarkian and the Appalachian Uplifts.

The distributional pattern of *Cryptobranchus* in the Ozarks shows that speciation within the North American group was accomplished forcibly by a head-water stream capture localized to the Black River system. This conception of limiting the differentiation of *Cryptobranchus* to this area is strengthened by an examination of the distribution of the striped shiner, *Notropis zonatus*. Hubbs and Moore (1940) indicate that the range of the subspecies *N. z. zonatus* includes adjacent tributaries of both the Missouri River drainage and the Black River, whereas the White River and tributaries and adjacent Missouri River streams show a marked faunistic break between them, with *N. z. pilsbryi* occupying the former and *zonatus* the latter streams. The occurrence of *Cryptobranchus bishopi* in Spring Creek of the White River drainage apparently represents an emigration from the original localized population of the Black River drainage. The occurrence of *alleganiensis* in Spring River of the Neosho River system illustrates, in all probability, a more recent stream and faunal capture from the Missouri River basin. It is interesting to note that *bishopi* and this population of *alleganiensis* have remained localized, and are restricted by the upper steep gradient areas of their respective streams. These animals have not been able to move down to the lower valleys. The Missouri River, on the other hand, has a lower gradient by comparison, and *alleganiensis* has become dispersed from this area to the Mississippi River and its valley. Except for a small isolated population in Iowa,* dispersal has been eastward.

The invasion of the Appalachian Uplands by the Cryptobranchidae seems to be of recent origin, the Ohio River forming the pathway to the east. In this highland area there are many instances of the spread of this species by means of stream capture. Coastal streams of Georgia and North Carolina are occu-

* Bishop (1943) mentions Iowa but no specimens are available. Mr. Lowell S. Miller of Parsons College, Fairfield, Iowa, relates that his Zoology students have obtained this species in Skunk River, in south-eastern Iowa.

pied only in their upper headwater regions. The Tennessee River evidently received its population through stream capture involving its upper tributaries (French Broad Creek, *etc.*). The lowest station on the Tennessee River where this species has been found is at Florence, Alabama (Univ. Mich. Mus. No. 66760). The Susquehanna River system, in turn, also received a *Cryptobranchus* population by stream capture in its western headwaters involving the Allegheny River system to the west (Netting, 1932: 174). Not all of the river systems in the Appalachians are occupied, however, which leads one to believe that this area did not form the original site for the dispersal of the genus. *C. alleganiensis*, for instance, is recorded from the upper Youghiogheny River of the Ohio River system but not from the adjacent eastward flowing north branch of the Potomac River.

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Observations on a Captive Gila Monster[1]

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On May 14, 1946 at 8 o'clock in the morning the writer, driving southward, was nearing Hermosilla, Sonora, Mexico. Observing a Gila monster (*Heloderma suspectum*) to crawl across the road ahead of the car, a stop was made. The writer easily overtook the big lizard as it lumbered along in a determined way, deviating just enough to miss large stones and other obstructions. On being approached closely, the animal immediately stopped his forward progress and assumed a defiant attitude with legs braced, head elevated and mouth open. Several violent hisses were given as it snapped at the stick with which numerous attempts were made to pin the animal on its back. Its writhing demonstrated strength and persistence. It appeared to have better coordination and greater agility in the fight than in the previous flight. The statement (Woodson, 1944) that the species is aggressive in nature and docile in captivity was, at least, half true.

A quick survey of the animal's environment disclosed a relatively level terrain sparsely covered with chaparral and scrubby trees characteristic of the Upper Sonoran Life Zone. No human habitation or other indication of open water was in sight. Where did the Gila monster drink? When would it get its next meal? How often must it take water and food? If the eggs of birds are the principal item of diet, can this lizard endure the fast of some eight or ten months between the breeding seasons of birds?

But little is known of the habits of this animal and fabulous tales comparable to those of many kinds of snakes (Schmidt, 1929) are frequently heard about the Gila monster. Therefore, the opportunity seemed at hand for observing and learning certain truths about the Gila monster.

With due respect for the venomous nature of the Gila monster (Woodson, 1947), an improvised cage was made from a gallon oil can and a bit of screen on the following day. The animal was transferred to it and kept without food or water until the writer returned on May 23.

On arriving in Los Angeles, after its fast of nine days it was assumed that the animal was hungry, and a live, one-fourth grown white rat was placed in the cage. The rat showed no fear of the Gila monster and frequently climbed on the lizard's back. The Gila monster was alert to the movements of the rat, followed it about the cage and repeatedly thrust out its tongue and touched it. The following day (May 24) a hen's fresh egg was placed in the cage, which egg the lizard ate almost at once. Three days later the rat was removed, as the lizard had not been observed to make any attempt to attack it (Hensley, 1949).

Although eggs were fed for months thereafter, several other types of food

1 Contribution of the Allan Hancock Foundation no. 57.

were offered. For example, on May 30 and 31 a horned lizard, *Phrynosoma*, was caged with the Gila monster. Apparently the horned lizard was not considered as appropriate food and the Gila monster did not even test it with the tongue. At a later date lizards of the genera *Gerrhonotus* and *Sceloporus* were placed in the cage. The presence of these smaller lizards produced no positive response from the Gila monster, and after a time they were removed. Bits of fresh raw liver were offered on August 2. These were tested with the tongue but not eaten. Perhaps the refusal to eat this latter item was influenced by the large number of eggs then being consumed by the Gila monster.

GROWTH

During the summer of 1946 the Gila monster was observed to eat only hens' eggs, which, in general, agrees with the observations of Ditmars (1936) and Ortenburger (1926), whereas Woodson (1948) fed his captives hamburger mixed with the beaten contents of egg.

From May 23 (when the first egg was fed) to June 21 (28 days later) 4 fresh eggs were offered at intervals of about 10 days. Each egg was eaten promptly by the Gila monster. Starting July 15, incubated hens' eggs were available in such numbers that the Gila monster was fed all it would eat. The eggs were fed one at a time, an egg being added only if the previous one had been entirely eaten, even though I planned to be away from the laboratory for a week. The reserve supply of eggs was kept in refrigeration to retard spoiling.

From July 15 to September 5 (52 days) 27 of these stale eggs were eaten. On three occasions two eggs were eaten in one day. The average was slightly over one-half egg per day. Although a constant supply of eggs was available to the Gila monster thereafter for 39 days (until October 14) only 5 eggs were eaten. After the latter date the animal refused to eat.

The Gila monster showed great gains in mass with the abundance of food and reduced exercise (see table 1). From the initial weighing on May 23, near the beginning of captivity, until July 26 (64 days later) the weight increased from 277 to 579 grams. This is a gain of 302 grams or 109 per cent resulting from the feeding of 13 hens' eggs. On August 30 (35 days later) the animal weighed 622 grams or a gain of 43 grams or 7.4 per cent on 15 eggs. On September 23 (24 days later) the animal weighed 635 grams, a gain of 13 grams or 2.1 per cent on 4 eggs. This was the last weighing of the animal for the season, but because it ate only 5 more eggs and these in the following 34 days, and because its actual and relative rate of gain had markedly decreased since easly summer, it may be assumed that the maximum weight never greatly exceeded 635 grams.

The gain in weight of the Gila monster relative to the amount of food eaten is an interesting study. Eggs averaged 54 grams each. Table 1 also shows the ability of the animal to utilize food at various seasons and during various stages of growth and fattening. In the first feeding interval (spring and early summer) the ratio of grams gained in weight to grams of food ingested was 1:2.3, whereas, in the late summer and early autumn the ratio increased to 1:19.2 and 1:15, respectively. It appears that in the utilization of food, efficiency is higher in the spring when the animal is in poor flesh.

TABLE 1.—Growth chart for the Gila monster (period is in days, measurements in millimeters, weights in grams, figures in columns with asterisk are averages).

		Length		Girth		Gain					Grams of egg	
Date	Duration of period	total	tail	abdomen	tail	Wt. in grams	gm.	%	gm./da.*	Eggs eaten	/da.*	/gm. gain*
1946												
5/23	0	—	—	—	—	277	—	—	—	0	—	—
7/26	64	400	—	—	—	579	302	109	4.7	13	11	2.3
8/30	35	403	140	201	100	622	43	7.4	1.2	15	23	19.2
9/23	24	408	135	193	105	635	13	2.1	.6	4	9	15
1947												
10/3	378	404	—	159	82	373	−262	−41	−.7	5	.7	—
10/23	25	420	—	—	84	338	−35	−9.4	−1.4	0	0	—

On October 3, 1947, over a year later, the animal nearly starved, weighed 373 grams, a loss of 262 grams. At death the weight was 338 grams, only 61 grams greater than that at the beginning of captivity.

Because of its aggressiveness during the first months of captivity, no attempt was made to measure the Gila monster. However, on July 26 it appeared sufficiently docile for limited handling and it proved to be 400 millimeters in total length (snout to tip of tail). On August 30 and intermittently thereafter, measurements of total length, length of tail, and maximum girths of abdomen and tail were taken (see table 1). Allowing for possible error in measuring and variation in muscle tonus, it may be assumed that the animal increased only slightly in total length but, in girth of abdomen and tail, it varied directly with the amount of food consumed. On September 23 the tail was estimated at maximum distension and the skin of the abdomen was stretched taut. At death the girth of tail was 84 millimeters, a shrinkage of 20 per cent from the maximum measurement of 105 millimeters.

This subadult Gila monster gained but slightly in length although it increased greatly in mass during the first summer with the abundance of hens' eggs. Although it was inside the laboratory, which was kept at a comfortable room temperature, it refused food after October 1946 and lost weight during the following winter. No additional food was offered in the spring and summer of 1947. The uneaten egg of the previous autumn remained untouched in the cage. By October 1947 the animal was exhausted from hunger and thirst. Perhaps such animals cannot assimilate food when the room- and body-temperatures are below that of normal summer heat. Forced feeding was tried once with no apparent detrimental results, in fact, the animal was temporarily revived. Nevertheless, starvation progressed and, on October 28, 1947, the Gila monster was observed dead in the cage.

Measurements taken at different times varied with the degree of muscle tonus, whereas after death, the body was flaccid and the measurements taken at that time seem unusually large.

The girth of tail seems to be a better indicator than girth of abdomen in determining the relative amount of stored food (Cochran, 1943). Maximum distension of abdomen was reached in August 1946 while the animal was still gorging. After that date this measurement decreased slightly. However, the girth of tail showed an increase even on September 23 although the animal was then eating less than an egg each week. At death the girth of tail was 84 millimeters (80 per cent of the maximum measurement for that organ).

In the long period of starvation the loss in weight per day averaged .7 grams. In the last 3 weeks of life, when the only food was a few cubic centimeters of egg and water fed by force, the average loss in weight per day was 1.4 grams.

It would appear that a well-fattened animal could withstand, without seriously detrimental results, a full year of fasting. The reason this particular animal did not rally probably lay in my attempts to terminate the starvation period at a season when the temperature of the environment was so low that the Gila monster could not utilize the food. It is generally assumed that at low environmental temperatures, and consequently at low body temperatures, ingested food undergoes putrefaction instead of digestion, which process is thought to be lethal to the animal. Nevertheless, the feeding of spoiled eggs during the previous year led to no more harmful results than occasional regurgitation.

EATING

During captivity the Gila monster was observed to eat only hens' eggs. Such eggs are much larger than those usually available in the animal's habitat. The manner of opening these eggs varied but little. The first egg offered was at room temperature and was attacked within ten minutes. With difficulty the mouth was opened widely enough to seize the egg. In the first attempts, the sharp teeth merely scraped over the shell with a grating sound and the egg slipped away. When the egg became immovable in a corner the animal itself was forced backward as the jaws closed. However, with the toes well braced in cracks the Gila monster was able to apply enough horizontal pressure to eliminate the slippage of the teeth and the shell was broken. This occurred three minutes after the first attempt to break the egg. On another occasion I counted ten futile attempts to bite a hole in the egg before the shell was fractured.

The break in the shell occurred on the side of the egg midway between ends, never on the end as recorded by Ditmars (1907). Lapping with the tongue began as soon as the albumen was exposed. On one occasion, it began before I could perceive a break in the shell. Following the break, the egg seemed to be accidentally oriented so that the window was on top and but little of the contents was lost. On one occasion the egg rolled so that the window was on the side opposite the Gila monster. The animal prepared to open a new window in the shell but the egg again rolled so the window was in the original position and lapping was resumed. In spite of the animal's clumsiness and stupidity, there appeared to be some economy in the manner of feeding.

In lapping, the forked tongue was extended one-half the length of the animal's head from the opened mouth into the albumen, and, without cupping dorsally or ventrally, was withdrawn into the mouth with a downward jerk of the head. The mouth was again opened by raising the upper jaw and cranium. This "chewing with the upper jaw" was particularly conspicuous as the animal lapped up the spots of albumen spilled on the floor of the cage. In this process the animal lay prostrate with the lower jaw immovable against the floor. The tongue was extended from the well-opened mouth, as before, but before it reached the limit of the stroke it curved ventrally until the tip touched the floor. Additional extension caused the formation of a definite loop which might have been effectively used in scooping the egg into the mouth. However, on the retraction stroke the tip remained in contact with the original point on the floor until the tongue again became straight, in which position it was withdrawn into the mouth, at which time the mouth "banged" shut by the dropping of the upper jaw.

Considering the small amount of egg that could be ingested with a single stroke of the straight tongue, as well as the deliberate cadence of lapping (frequency about 1 per 2 seconds) it is not surprising that a half hour was usually necessary to consume an egg.

As the contents of the egg were lapped the window in the shell was periodically enlarged by crunching off bits of shell on both near and far sides. Occasionally the egg was lifted clear of the floor in the process. Eventually the nose could be inserted into the aperture. At this stage a gulping action, as if to break the yolk, was detected on one occasion. Occasionally during such rapid feeding the snout, dripping with albumen, would be withdrawn from the shell and elevated while tiny bubbles of albumen were wheezed and snorted from the nostrils and the tongue would be periodically extended at intervals of several seconds. The animal often rested several minutes before resuming its eating. Even during the long period of deliberate lapping, it would pause about every five minutes to stretch the trunk and elevate the head, sometimes almost to the vertical, perhaps to let the food run down its throat (Ditmars, 1907). At such times exaggerated swallowing movements could be observed as well as abdominal contractions.

The slow, jerky, rhythmic, lapping motion was generally used from the time the shell was broken until the last trace of albumen was removed from the shell and cage floor about 30 minutes later. If the animal was particularly hungry it might continue to lap the empty shell and bare floor for 10 minutes after the egg was apparently all consumed.

In gaining access to the contents of the egg, the shell was seldom cut more than three-fourths around although occasionally it was halved, or even crushed to bits. On one occasion it was neatly opened by the removal of the top half of the shell. Whenever the lizard was well fed the window was symmetrically formed with neat margins. It is assumed the animal was particularly hungry or restless whenever the shell was excessively mutilated.

Fragments of shell could always be found near the site of feeding but these were never equal in area to the opening. Apparently most of these frag-

ments were accidentally or intentionally eaten with the contents of the egg. At one time the animal was observed to attack an empty shell, crush it to bits and nibble at fragments. Empty shells were usually left in the small, low food pan but occasionally they were found in the cage proper and once in the adjacent compartment on the far side of a three-inch-high wall.

After the meal was finished the animal would usually elevate the head from 45° to 90° from the horizontal for a considerable time. On such occasions spasmodic twitchings, probably peristaltic, of the lateral muscles of the throat and abdomen were often observed.

Freshness of eggs.—The degree of freshness of the eggs appeared to have but little effect on the number of eggs eaten, the speed of eating, or the thoroughness with which the contents were cleaned up. On July 15 the first stale egg was offered. Although the animal had eaten no food for 25 days, the egg was not eaten until the following noon. The cage was visited near the close of the feeding. The contents of the egg smelled strongly of sulfur and the albumen was very dark. Nevertheless it was as thoroughly cleaned up by the Gila monster as were the fresh eggs.

The Gila monster did refuse one egg that appeared to be excessively stale. The animal had eaten an egg on the previous day, August 19. The stale egg remained untouched at least until noon of the following day. When I returned to the cage at 4 p.m., the egg had been opened in the usual manner but little if any of the contents had been removed. The egg appeared very old and disintegrated although there was but little odor of hydrogen sulfide. The yolk had broken and colored the albumen yellowish brown. Some of this had spilled over the side of the shell and had dried to a putty-like consistency. When it appeared that this egg would not be eaten, it was removed and an egg of about 12 days incubation was offered. This latter egg contained a living embryo of about the same volume of the then-present yolk sac and it could be observed through the ¾ by 1 inch window previously cut in the shell. The warm egg was untouched by the Gila monster that day. At noon the following day (August 21) the egg was undisturbed. However, at 1:30 p.m. of that day I observed that the embryo, yolk sac and the remaining albumen had been eaten. Only the "bloody" embryonic vessels with certain embryonic membranes still adhered to the inside of the shell.

Temperature of eggs.—The first series of fresh eggs given at intervals of several days and at room temperature were eaten the same day as offered. Most of the series of stale eggs next fed had been stored at 45° F. for a time previous to feeding. Of the cold, stale eggs offered the Gila monster, only 6 were eaten the same day as offered—one after only one and one-half hours, others after 3 to 5 hours, and on a cold foggy day (September 24) one after 9 hours.

The cold egg offered at 1 p.m. on July 24 was tested repeatedly with the tongue of the Gila monster 25 minutes after being offered. The strokes of the tongue were at right angles to the long axis of the egg and the egg was lapped from end to end, first on the near side with the dorsal surface of the tongue and then on the far side with the ventral surface of the tongue. Sev-

eral times the Gila monster paused as if to eat the egg but made no move to crack the shell. After 5 minutes of testing, the animal crawled into another compartment of the cage. However, at 4 p.m. the animal was heard to break the shell and then to eat the egg.

A stale egg at room temperature was offered at 2:30 p.m., September 3. This was immediately after the Gila monster had finished another egg that had been regurgitated. One and one-fourth hours later the egg was half eaten.

From these observations it may be concluded that "nest warm" eggs have no particular attraction to the Gila monster, and that eggs at room temperature are satisfactory, whereas those near 45° F. appear too cold to be eaten.

Recognition of food.—One egg placed in the cage was found by the Gila monster 20 minutes later. The animal crawled to it and stopped with the snout ¾ inch away from the egg. It slowly extended its tongue, touched the egg and withdrew its tongue. This was repeated 10 times with a strange, slow rhythm (about 1 per 5 to 10 seconds). On another occasion the Gila monster presumably recognized the egg placed at the far end of the cage, approached it, sniffed it, snorted once, then began feeding.

Apparently vision is poorly developed in the Gila monster. The sense of smell may be acute although it appeared that the eggs were found merely by accident or by trial and error.

DRINKING

On July 24 a bottle (8-ounce inverted with a 1-hole stopper in which was inserted a short, curved, small-bore copper tube) of water was installed in the cage. On August 5 (12 days later) the volume appeared unchanged. Suspecting evaporation in time might lower the level, a second check bottle was installed alongside the first bottle but with the outlet outside the cage beyond the reach of the Gila monster. On August 14 no noticeable reduction of water was detected in either bottle. However, between October 29 and November 7 evaporation appeared to be lowering slightly the level in both bottles. On November 15, one month after the last egg of the season was eaten, the Gila monster was observed for the first time to lick the outlet of the bottle and later in the day to enclose the copper tube in its mouth. It apparently drank about a half ounce of water. On December 18 the drinking bottle was found empty and the check bottle had 1 ounce of water in it. Apparently the Gila monster had drunk at least 1 ounce of water during the preceding month. No further water seems to have been taken.

Because of the emaciated condition of the animal on October 3, almost a year later, a dish of water was offered, but none was taken although the animal's snout was forced into it. The bottles were refilled October 6 but there was no indication of the animal drinking thereafter. On October 8 the animal suffered a near sunstroke, and, because of the general weakened condition, some 10 drops of water were forced down its throat. This quickened its movements and responses, and, with a few cubic centimeters of egg albumen forcibly fed, the animal soon appeared almost normally alert although the skin hung in baggy folds over the shriveled body. The offered fresh egg was ignored.

Thinking the animal was too weak to crack the shell I opened a window in it so that the moist contents would be easily available. This was on October 10, a few days before the animal's death. The egg remain untouched. The last egg of the previous year had been eaten on October 14.

It is assumed that, in general, the Gila monster obtains all its water from the native food it eats. When the weather becomes too cold for further eating, the animal may still take open water, if available.

ELIMINATION

Regurgitation.—At 9 a.m. on August 14, a month after heavy feeding started, the Gila monster was observed as it was finishing the egg offered on the previous day. The animal's snout, recently withdrawn from the shell, had albumen on it. In the corner of the compartment of the cage opposite the food pan was a wet spot in the sand plus some small fragments of shell as if the animal had just regurgitated part of its meal. The cause probably was not an excessively stale egg because many other eggs eaten and successfully retained were in a worse condition than this one appeared to be. Possibly the animal was too full, as this was the third egg in three days.

On September 3, after a 3-day fast, an egg was offered in the morning and by 1:45 p.m. it was nearly consumed. At 2:30 p.m. I observed a small mass of white and yellow material directly in front of its nose. There is but little doubt that this was part of the recently eaten yolk and albumen. Another egg, this one at room temperature, was offered at the time of the above observation. An hour and a quarter later it was half consumed. No regurgitation was observed after this feeding although it was the second egg for the day.

From these observations it appears that regurgitation may sometimes be a normal process and not necessarily the result of excessive gorging or improper food. Ortenburger (1926) thought that excessive heat and motion suffered by a Gila monster riding in a truck had caused it to regurgitate.

One of the erroneous popular concepts about the Gila monster is that the animal has no anus (refuted by Bogert, 1948), thus necessitating the elimination of all wastes through the mouth and contributing to the venomous bite of the animal.

Feces.—On May 31, 7 days after the eating of the first hen's egg, a mass of fresh feces was observed in the cage of the Gila monster. In size, color, odor and consistency it resembled the cloacal wastes of an incubating domestic hen after many days of inactivity. The feces consisted of solid matter, semisolid matter and liquid.

The solid, doughy mass was nearly cylindrical and measured 22 millimeters long and 15 millimeters in diameter. It was sufficiently solid, even while fresh, to be lifted without distortion with tweezers. This nearly pure white mass formed the bulk of the feces.

The semisolid matter was albumen-like in consistency and of a dull greenish color. Although it would stand alone it was too nearly fluid to be picked

up with the tweezers. In color and consistency it resembled the contents of the caecum of a domestic rabbit fed on commercial pellets containing alfalfa hay.

The liquid part of the feces resembled urine in density and odor. It could not be collected from the board floor of the cage. The solid and semisolid parts weighed 8 grams and the liquid part was estimated at 2 grams.

An attempt was made to determine the variations in frequency of defecation. Regardless of my occasional absences and the tramplings by the Gila monster, a reasonably accurate count was possible because the dried white matter formed a durable, easily recognized scat. A single white chalky scat was observed in the original improvised cage when the animal was removed on May 23. It is strange that this was not ground to powder because there was no sand or bedding in the small metal cage and the animal was particularly restless, as indicated by its laborious scratchings heard intermittently in the nights afield. This defecation occurred between May 18 and May 23.

In the first six-week period of intermittent feeding of fresh eggs, 6 scats were observed, which averaged 1 defecation per week. A count of fresh feces (3) and dried scats (7) from July 19 to August 14, a period of maximum feeding, indicated 10 defecations in 26 days or about 1 per 2½ days. The defecation on July 26 occurred while the animal was being handled for weighing. It defecated with a strong squirt that shot the liquid several feet across the room, and made an audible sound. The 7 dry scats were of similar size and averaged 2.36 grams in weight.

On August 30, 3 scats were removed from the cage. These, plus the fresh feces of the day, totaled 4 defecations for the previous 15 days or about 1 per 4 days. The consumption of eggs was as great as in the previous period with 1 scat for each 2½ days.

Because of my other pressing interests the animal was observed only casually thereafter for about one year. In the dormant, semi-dehydrated condition eliminations were less frequent. During this period most of the feces were lost in the sand in the cage. However, on October 3, 1947 two pellets were observed in the cage. The larger (28 millimeters long and 15 millimeters in diameter) weighed 2.6 grams. It smelled of ammonia although it appeared to be air dry. The smaller one weighed 1.6 grams. It was older, badly eroded and practically odorless. On October 9, 18 days before death, a defecation, no more than 24 hours old, was observed in the cage. This was the last one voided.

Besides variations in frequency of defecations, differences in water content, form and pigmentation of feces were observed. With progressive starvation and desiccation the volume of solids per defecation remained about the same, eliminations became less frequent, the water content was lower, pigmentation increased, and the white masses showed deeper transverse creasing.

The white, doughy, amorphic, solid matter of the fresh feces formed the dried chalky scats. They varied in form from subcylindric to flattened conical or to a series of discs. A film of tiny yellowish crystals on parts of the

whitish mass proved to be entirely uric acid, the product of the kidneys (Baldwin, 1948, p. 259).

With starvation, the voided white solids became more nearly cylindrical and the circular grooves more pronounced, so that the scat resembled the rattle of a rattlesnake. These grooves allowed certain scats to be readily broken transversely into two or three thick discs.

The semisolid matter was greenish or greenish-brown while the animal was fed on a light diet of eggs. On August 30, 1946, near the end of gorging on stale eggs, the color was yellowish-orange as of a hard-boiled egg yolk and the consistency of the albuminous mass was heavier.

With starvation, pigments on the white scats further increased in area, kind and density until, on October 3, the recently eliminated scat was only 1/3 white, the rest was yellow, except for a curly tip that was jet black. On October 9, when the animal was nearly dead, a scat no more than a day old was half mottled white and yellow, and half jet black with rugose surface.

After death the rectum where the feces formed, measured 28 millimeters long and 15 millimeters in diameter, which corresponds to the measurement of the largest scat. The rectum contained an internal fold, somewhat spiraled, around the lumen, which fold probably produces the characteristic creasing in the scat.

ACTIVITY

The rate of activity of my Gila monster varied widely with changes in temperature, food, water and radiations. In general, the animal was more active when warm, when in mild sunlight, when hungry and when eating.

On October 29 it was observed that lethargy from cold occurred at about the same temperature and to the same degree in the Gila monster as it did in the local *Sceloporus* lizard that was in the same cage at that time. Exaggerated activity often followed the eating of an egg but usually within half an hour the animal became quiet. This immobility might then last for several days. After a year of starvation the small amounts of egg and water forcibly fed greatly stimulated the animal to almost normal activity.

The animal often maintained lateral body contact with the vertical wall of the cage. Usually a jaw, side of forearm, neck, trunk, hip and side of tail would be in contact with the wall. Occasionally the head, inclined at 30° to 45° from the horizontal, would be propped on the low partition or elevated nearly to 90°, rested against the end of the cage. While in these positions the eyes would be closed and the respirations so slight and infrequent as to be undetectable. Occasionally abdominal breathing was evident, sometimes expressed in a great audible sigh. Presumably air was also pumped by action of the throat muscles.

Occasionally activity was greatly exaggerated. While still in the original cage in Mexico, the animal's monotonous scratchings were heard intermittently through the night. Later in the summer it scratched for hours at a time at the walls of screen. A month after entering a lethargy for the autumn it roused and, for several days, was excessively restless, and spent much of its

time hanging on and scratching at the hardware cloth at the top of the vertical walls of the cage.

On one occasion the Gila monster was heard to hiss like a snake. This was assumed to be a challenge or warning associated with fighting. Fear was shown at the rustling of a paper on which an offered egg was placed. Although left overnight in the cage the animal did not approach the egg and eat it until the following day, after the paper had been removed.

SHEDDING

Old skin came off the Gila monster in patches, not in a single piece as in snakes and some lizards. On the lethargic animal, whenever abrasion was slight, a loosened patch might include several square inches of skin. At such times the animal appeared very "ragged." When the animal was active the loosened pieces were broken off in small fragments containing only a few scales each. These were further broken up by the tramplings of the animal itself.

Apparently molting is a continuous process. However, at certain times, for example, October 1946, there seemed to be a general molt of the whole animal that occurred in a few weeks. Great patches loosened first on the abdomen, later on the sides and then on the neck. These remained undisturbed for days before falling off. The new skin was colorful and shiny.

ACKNOWLEDGMENTS

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An Abnormal Earthworm

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An earthworm recently collected in the vicinity of Waterville, by a student, Harold Kent, is characterized by a hitherto unrecorded type of abnormality.

Description of the Specimen

External characteristics.—Length, 72 mm. Diameter, 4 mm. Segments, 163; all intersegmental furrows well marked, complete, and normal throughout. Prostomium slightly proepilobous.

Setae closely paired; *ab* ca. = *cd*, *aa* > bc, *a* and *b* of xiii, xiv, xv (left side only, + 4), xxxiv (+2), xxxvi (+ 2), and xxxviii (left side only, + 4) modified and within parietal tumescences. Setal numbers, four pairs per segment, normal throughout.

Spermathecal pores on 14/15 and 15/16 (+ 5), in region of *cd*. Female pores on xix (+ 5). Male pores on xx (+ 5). Clitellum on xxix, xxx-xxxvi (+ 2 posteriorly only), not protuberant but intersegmental furrows obliterated. Tubercula pubertatis on xxxiii-xxxv (+ 2).

Internal anatomy.—Septa are complete and attached normally to the parietes throughout. Calciferous sacs in xiv, calciferous glands in xv-xvi (+ 4). Intestinal origin in xvii (+ 2). Gizzard in xix-xx (+ 2). Lateral hearts, large, in viii-xv (+ 4 posteriorly).

Testes and male funnels in xv-xvi (+ 5), funnels and vasa deferentia with marked spermatozoal iridescence, coelomic cavities of xv-xvi filled with testicular coagulum. Seminal vesicles in xiv-xvii (+ 5), those of xv small. Ovaries and female funnels in xviii (+ 5). Ovisacs in xix (+ 5), somewhat enlarged, with white, spheroidal lobulations. Spermathecal ampullae translucent.

Discussion

Spermatozoal iridescence of male funnels indicates sexual maturity but absence of iridescence or opacity in the spermathecal ampullae indicates that copulation had not taken place or had been unsuccessful.

The tubercula pubertatis of the worm described above are like those of *Allolobophora caliginosa* (Savigny) 1826, except for segmental location, and are unlike those of each of the other twelve species of Lumbricid earthworms that is found in the Waterville area. Other structures of taxonomic importance, with exception of the prostomium, and of course the segmental location of certain organs, are as in *caliginosa*. In absence of further and more definite

contraindication, the worm is identified as *A. caliginosa*. This identification enables determination of the various organ displacements as indicated in the parentheses above, the plus sign indicating posterior displacement and the figure the number of segments of displacement.

The difference in shape of the prostomium appears to be of little importance in the present connection. The variant conformation can be explained as due to regeneration as it has been found (Gates, 1949b) that prostomia of otherwise normal head regenerates may be atypical in one Lumbricid species (records of other atypical variations not yet published).

Especially noteworthy is the fact that metamerism, as shown by intersegmental furrows, setae, septa and nephridia, is normal throughout, both externally and internally. Furthermore, with possibly one exception, there are no duplications of structures as found in certain types of earthworm abnormality. The vascular system, at first, appears to provide an exception, as there are three extra pairs of large lateral hearts (the pair normally present in the second testis segment lacking). The extra hearts may be only hypertrophied and modified segmental vascular commissures.

Otherwise abnormality mainly comprises dislocation of organs. All dislocation is posterior and laterally symmetrical (*i. e.*, the same on both sides), a combination that appears to be very rare in the Lumbricidae. One explanation that has been suggested in the past for posterior and symmetrical homoeosis is hypermeric regeneration (Gates, 1949a). However hypermery of more than + 1 has not yet been recorded from any lumbricid species and appears to be ruled out of further consideration by lack of uniformity of organ dislocation.

All internal reproductive structures and their external apertures are dislocated posteriorly by five segments. Certain structures of the digestive system are also dislocated posteriorly but not by the same amount as the reproductive organs nor uniformly, the calciferous structures with a homoeosis of + 4 while the gizzard and intestinal origin show a homoeosis of only + 2. External reproductive structures that develop only late in life, at sexual maturity, appear also to vary in amount of dislocation. The genital setae apparently show a homoeosis of + 2 and + 4 but location of these structures in normal animals of the same species is subject to some variation. The clitellum in part appears not to be homoeotic (anteriorly) but does extend posteriorly over two more segments than usual (+ 2 ?). However the clitellum probably had not yet reached maximum development as far as epidermal thickness is concerned and may not have attained full development in segmental extent.

As the dislocations cannot be explained by hypermeric regeneration the origin must be sought in the period of embryonic development and presumably at a fairly early stage. The differential homoesis suggests that at least two different factors or causes were involved. Possibly extent of clitellar development, and differentiation of genital setae, was determined later on, some time after hatching, and as a resultant of previous determination. Although there is

considerable interspecific variation, in the family Lumbricidae, as to location of clitellum and genital setae, nothing seems to be known of the morphogenetic determiners involved.

SUMMARY

An earthworm, identified as *A. caliginosa*, was characterized by metamerically uncomplicated, symmetrical, posterior and differential homoeosis of the reproductive and certain digestive and vascular organs. The origin, at least in part, is to be sought in an early period of embryonic development.

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The Cespitose Lupines of Western North America

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The cespitose lupines which are the subject of the present discussion are inhabitants for the most part of the moderately arid regions of the western United States and southwestern Canada, ranging in a great arc from the Rocky Mountains of central Colorado northward through Wyoming, westward along the Sierra Nevada to the San Bernardino Mountains. They are absent from the humid slopes west of the Coast Range summits and rare in the desert regions of the Great Basin.

They constitute a group whose members plant taxonomists have all agreed are closely related to one another. The number of species recognized has varied considerably according to the interpretation of the individual workers. Agardh (1835) included in his monograph of the genus *Lupinus* two western American cespitose species, basing his observations largely upon the collections of David Douglas. He assigned them to quite different sections, however, placing *L. lepidus* in the *Polyphylli*, while *L. aridus* was classed with the *Sericei*. Torrey and Gray (1840) listed three species in this group. Watson (1873), in the first comprehensive treatment of the North American lupines after Agardh, recognized five species and three varieties. Piper (1906) gave three species for the state of Washington, classifying them under the section *Sericei*. The group was divided into two sections by Rydberg (1922)—the *Lepidi* including *lepidus* and *aridus*, while the *Caespitosi* were made up of *caespitosus*, *Cusickii*, and *Watsonii*. This was apparently the first application of either of these section names in this complex. Retaining the name *Caespitosi*, Charles Piper Smith (1927) listed under this section four species and four varieties as occurring in Oregon. The same author, in his *Species Lupinorum* (1946), has referred to all of these merely as the "*caespitosus-lepidus* complex." Jepson (1936) recognized nine varieties under two species as occurring in the California flora. Peck (1941) recognizes four species and four varieties for Oregon. Finally Abrams (1944), under the section *Caespitosi*, has included four species and nine varieties as occurring in California, Oregon, and Washington.

None of the studies so far published has emphasized the distribution of the various entities, nor attempted to explain the significance of this distribution in terms of environment or of evolution.

A previous investigation by the writer in species distribution (Detling 1948a) suggested the importance of environmental extremes in the evolution and distribution of species and subspecies. It was with this in mind that the initial work on the present study was approached. The analysis of the lupine populations which has furnished the foundation of this treatment was based upon the system of vegetation areas recently worked out and described for the Pacific Northwest (Detling 1948b). These areas are constructed around

centers of environmental extremes. Without reviewing the method used in establishing the vegetation areas, we present here a map (Fig. 1) showing the boundaries of those which we have used in this study.

Nine of these areas have yielded collections of cespitose lupines in con-

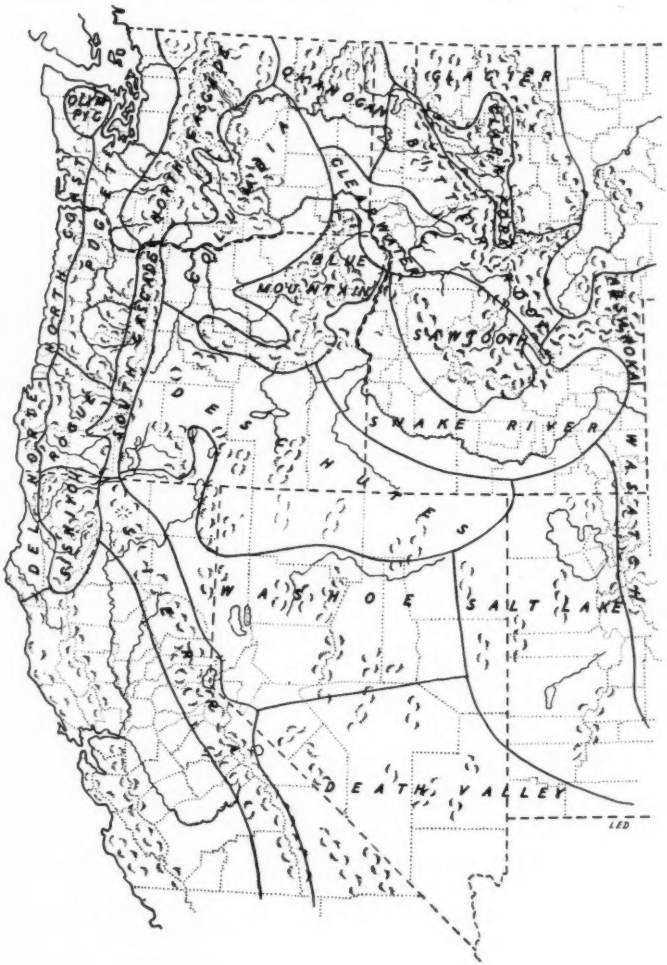

Fig. 1.—Vegetation areas of the Pacific Northwest.

siderable numbers, viz., Sierra, Rogue, South Cascade, Puget, North Cascade, Columbia, Deschutes, Blue Mountains, and Absaroka. These form the basis for the distributional aspect of this investigation. Where available collections from a vegetation area were found to be so few that statistical data based upon them were considered undependable, such an area has not been included in the tables and graphs of this study. Such collections have been carefully studied, however, and compared with those of adjacent areas and the results incorporated in the general taxonomic treatment. By such comparisons collections from the Sawtooth Area of Idaho and some of the areas of the Rocky Mountains of Colorado and Wyoming are found to be similar to those of the Absaroka Area of northwestern Wyoming and northeastern Idaho, and in the preliminary studies the Absaroka Area has been taken as representative of this larger region. The few collections available from the Washoe Area are of the same type as those from the lower and middle elevations of the Sierra Area. The occasional collections from the Siskiyou Area are of the types found in the adjacent Rogue, Sierra, and South Cascade Areas.

The method of procedure in this investigation has been to select several diagnostic characters of the whole group of *Caespitosi*, make careful measurements of these in a large number of specimens collected throughout western North America, and then determine the mean, range, and mean deviation of each character for each vegetation area under consideration. These data reveal the geographical and ecological pattern according to which the major morphological forms of the cespitose lupines have developed.

The diagnostic characters selected for the analysis of the populations, and the methods of measuring the same, are the following:

1. *Plant height*, measured from ground level to the top of any foliage present, but excluding the inflorescence.

2. *Leaf size*, based on the mean length of the ten longest leaflets in the collection.

3. *Raceme length*, the mean length of all fully bloomed racemes in the collection.

4. *Degree of exposure of the raceme*, expressed as the percentage of the raceme exposed above the foliage of the plant, and is the mean of all the racemes in the collection.

5. *Size of the flower*, based upon the length of the wing petal exclusive of its stalk. This and the following measurement are taken from two or three fully opened flowers selected at random from any vigorous plant of the collection.

6. *Shape of the banner*, expressed as the ratio, greatest width/length (W/L), reduced to a decimal fraction.

Measurements were all made from dried herbarium specimens. The unit for measurements was all available material from a given collection rather than the individual plant. Most frequently the "collection" means all the plants on a single herbarium sheet.

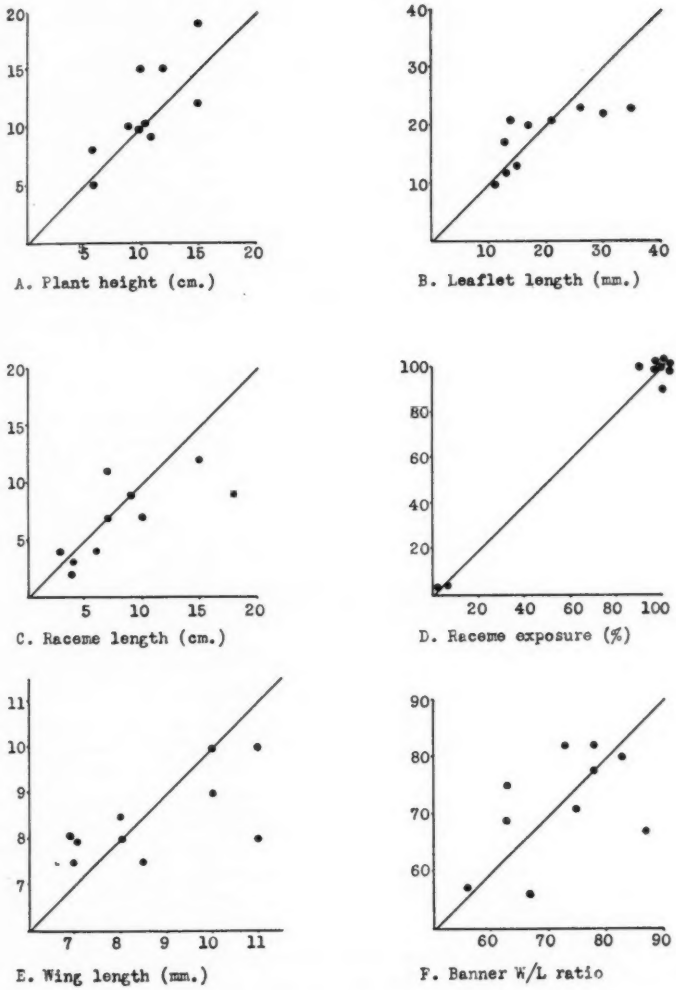

Fig. 2.—Measurements of six diagnostic characters in the parent (vertical scale) and offspring (horizontal scale) generations under cultivation.

In order to determine whether any of the morphological characters being used were sufficiently subject to modification under changed ecological conditions to invalidate them for taxonomic use, the author has grown most of the types under experimental garden conditions. While seeds were not available from all the vegetation areas considered here, the ones which were available were from plants in which all the key characters were represented except the partially exposed racemes of the mid-Columbia region. The plants, with one exception, Stevens and Brenckle 38-203 (SB203), were grown from seeds taken from the author's own collections. Plantings were made in a garden plot near Eugene, where conditions of soil, light, moisture, etc., were constant for all individuals. Herbarium specimens were made of all the offspring as they matured, and measurements of these were made in the usual way. Table 1 indicates the results of the experiment. The left-hand column of the table lists by collector's number the parent collections used in the experiment, while the remaining six columns give the means, for both parent collections and offspring, of the six morphological characters under discussion. The origins of the parent collections are as follows:

5822 Frog Camp, Lane Co., Oregon. South Cascade Area.
5816 Diamond Lake, Oregon. South Cascade Area.
5820 East slope of Cascades, 4650 ft., Klamath Co., Oregon. Deschutes Area.
5821 East base of Cascades, Klamath Co., Oregon. Deschutes Area.
5802 Williamson River, Klamath Co., Oregon. Deschutes Area.
4421 Wilderville, Josephine Co., Oregon. Rogue Area.
4422 Tenino, Thurston Co., Washington. Puget Area.
5739 Mehama, Marion Co., Oregon. Puget Area.
4460 Seneca, Grant Co., Oregon. Blue Mountains Area.
SB203 Spring Lake, Yellowstone National Park. Absaroka Area.

The correlations between parent and offspring measurements are shown graphically in Fig. 2 (A-F), in which the parent measurement for each character is plotted on the vertical scale and the offspring measurement on the horizontal scale. If the measurement of both parent and offspring of a given collection are the same, the position of that collection on the graph will fall on a diagonal line drawn halfway between the vertical and horizontal scales. It will be noted that a position below the diagonal indicates an increase in size, etc., under cultivation, while a decrease is shown by a position above the diagonal.

Two things are evident from the foregoing table and graphs:

1. In general, changed ecological conditions do not appreciably alter the relative sizes and positions of plant parts in this group of lupines. Tall plants remain tall, short ones remain short, unexposed racemes do not lengthen out to become exposed, etc.

2. Within the limits of this general statement, there may be increase or decrease under cultivation in the measurements in question.

However, these changes do not exceed the range of variability found within the subspecies from which the parent stock originated, as may be seen by reference to the systematic treatment in this paper. This being true, the results of

the experiment indicate that the characters under discussion are sufficiently well fixed genetically to warrant their use in a taxonomic study.

As a first step in the analysis of our data we have had recourse to the polygonal graph method as described by Hutchinson (1936, 1940), and as applied to a study of plant populations by Davidson (1947). For our purposes the six diagnostic characters are represented by six radii, each with its measurements marked off in a convenient scale. Each *Lupinus* collection is represented by a continuous line connecting the proper points of the scales on the radii, in such a way as to form a six-sided polygon which may readily be compared with the polygons of any or all other collections in the graph. One of the important things to be gained from an examination of the graph of a given area is the determination of whether or not the population comprises more than one entity. A bi-modal distribution of individuals on more than one radius, with positive correlation between the groups, may be taken to in-

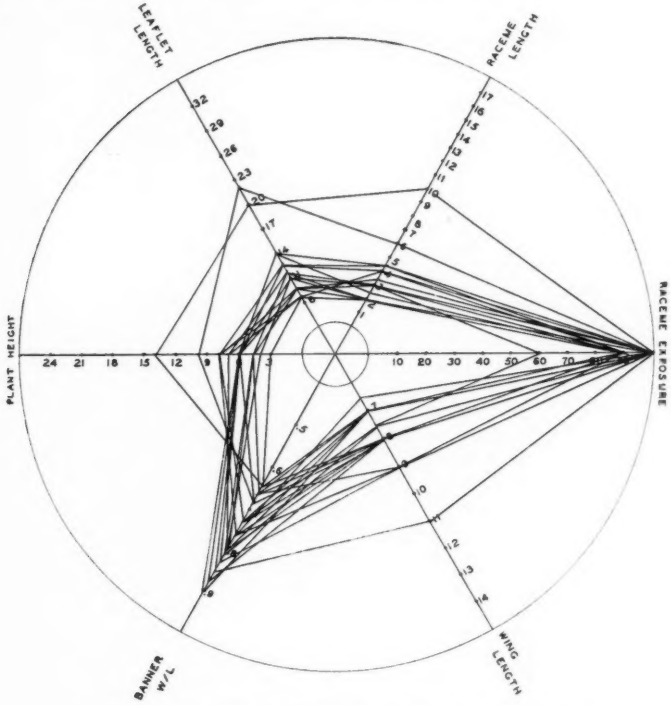

Fig. 3—Polygonal graph of six diagnostic characters for 22 collections from the South Cascade Area.

dicate the presence of two entities in the population. Our graphs show that in general there is one entity which is dominant in the population of each area. As an example of this situation we call attention to the graph for twenty-two collections in the South Cascade Area (Fig. 3). It will be noted that for all characters, except possibly shape of banner, measurements are concentrated in one part of the radius, with little scattering from the mean. In contrast with this we are showing the graph of twenty-three collections from the Sierra Area, the outstanding area in which more than one entity may be demonstrated (Fig. 4). In this graph the polygons for those collections having short racemes (2-4 cm.) show correspondingly small leaflets (8-13 mm.) and low stature (4-7 cm.), and these same polygons form a group noticeably distinct from those of the taller plants with larger leaflets and longer racemes.

A comparison of the morphological characters of the populations of various areas may best be made through a comparison of their means, especially

TABLE 1.—Measurements of six diagnostic characters in original collections and in their offspring under cultivation. (The upper number in each box is the mean for the parent collection, the lower the mean for the offspring.)

No	Plant height (cm.)	Leaflet length (mm.)	Raceme length (cm.)	Raceme exposure (%)	Wing length (mm.)	Banner W/L
5822	5	12	2	90	8	.67
	6	13	4	100	7	.87
5816	8	10	3	100	7.5	.75
	6	11	4	100	7	.63
5820	9	13	7	100	8	.78
	11	15	10	100	11	.78
5821	10	17	7	100	8.5	.82
	10	13	7	100	8	.78
5802	15	21	9	100	8	.69
	12	21	9	100	8	.63
4421	10	23	11	100	8	.71
	9	26	7	90	7	.75
4422	12	23	9	100	10	.80
	15	35	18	100	11	.83
5739	19	22	12	100	10	.82
	15	30	15	100	10	.73
4460	15	21	4	0	9	.56
	10	14	6	0	10	.67
SB203	10	20	4	0	7.5	.57
	10	17	3	0	8.5	.56

where graphs indicate that one morphological entity is dominant in each area. In the case of the Sierra Area, since it is evident that two entities are present in the population, it would hardly be proper to compare the means of this area as a whole with the corresponding means of other areas. For this reason, we have separated the population of this area into the low, small-leafed, short-racemed plants which will hereinafter be referred to as Sierra—1, and the taller, large-leafed and long-racemed plants to be known as Sierra—2. A summary of the range (R), means (M), and mean deviation (MD) of each diagnostic character throughout all the areas is presented in Table 2.

Examination of the table reveals that for each morphological character there is not only usually a variation in its measurements from area to area, but also this variation tends to throw the areas into two, three, or sometimes four groups so far as the possession of that character is concerned. This becomes much more clearly evident in a graph so constructed as to show the relative position of the mean of each area on a scale of the character meas-

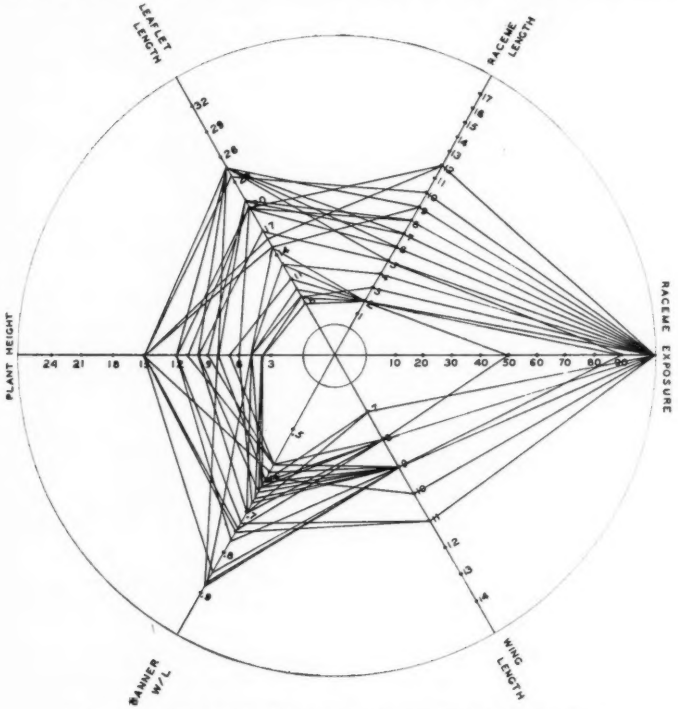

Fig. 4.—Polygonal graph of six diagnostic characters for 23 collections from the Sierra Area.

urements (Fig. 5). This graph shows how certain distinct types of each character are distributed among certain areas or groups of areas. The distribution may be summarized as follows:

Plant height.—The North and South Cascade and Sierra—1 populations represent one extreme of the series, namely low stature, while the tall plants of the Columbia and Puget Areas comprise the other extreme. Means of the Absaroka, Deschutes, Rogue, Blue Mountains, and Sierra—2 populations constitute a third group, of medium height.

Leaf size.—Three distinct types are discernible, the medium-sized leaves of the Deschutes population occupying a position about midway between the small leaves of the North and South Cascade and Sierra—1 and the large ones of the Absaroka, Sierra—2, Rogue, Blue Mountain, Puget, and Columbia.

Raceme length.—In length of inflorescence the populations fall into two fairly distinct groups, with those of the North and South Cascade, Absaroka, Blue Mountain, and Deschutes Areas forming a short-racemed group, and those of the Columbia, Puget, and Rogue Areas a long-racemed group, with the Sierra plants divided between the two groups.

TABLE 2.—Range (R), mean (M), and mean deviation (MD) of measurements of six diagnostic characters in the Absaroka (Abs), Blue Mountain (BM), Columbia (Col), Deschutes (Des), North Cascade (NC), Puget (Pug), Rogue (Rog), Sierra (Sa), and South Cascade (SC) Areas.

		Abs	BM	Col	Des	NC
Plant	R	5–12	7–16	7–25	4–15	2–10
height	M	9.0	10.9	13.8	9.5	5.1
(cm.)	MD	2.3	1.92	3.63	2.86	1.24
Leaflet	R	14–27	16–24	14–35	9–25	7–18
length	M	20.1	21.4	24.1	15.4	9.5
(mm.)	MD	3.2	2.3	4.62	3.48	1.45
Raceme	R	2–4	3–6	4–12	2–11	1–7
length	M	3.5	4.5	8.0	5.6	2.1
(cm.)	MD	.66	.68	1.76	1.65	.85
Raceme	R	0–0	0–100	10–100	0–100	100–100
exposure	M	0	18	54.5	89.0	100
(%)	MD	0	27.8	17.4	15.4	0
Wing	R	7–8	7–11	8–13	7–10	6–10
length	M	7.3	9.2	9.2	8.3	8.5
(mm.)	MD	.33	1.1	.78	.59	.75
Banner	R	.53–.67	.56–.94	.58–.85	.47–.82	.72–1.0
W/L	M	.58	.70	.71	.72	.84
	MD	.03	.09	.05	.06	.06

TABLE 2.—(*concluded*)

		Pug	Rog	Sa–1	Sa–2	SC
Plant height (cm.)	R	4–20	7–15	4–7	5–15	3–14
	M	13.0	10.3	4.8	11.1	6.5
	MD	3.16	1.76	.57	2.8	1.45
Leaflet length (mm.)	R	12–32	13–28	8–15	13–30	9–22
	M	23.4	21.3	10.2	20.8	11.9
	MD	3.09	3.57	1.57	3.85	2.4
Raceme length (cm.)	R	3–15	4–18	2–4	3–15	2–10
	M	8.9	10.0	2.3	7.5	3.1
	MD	2.6	2.7	.45	2.3	1.2
Raceme exposure (%)	R	80–100	90–100	50–100	90–100	60–100
	M	99	98	95	99.5	95.4
	MD	2.0	3.0	4.2	.95	6.2
Wing length (mm.)	R	8–12	6–11	7–9	7–11	6–11
	M	10.0	8.2	8.1	9.05	7.9
	MD	.6	1.1	.47	.95	.64
Banner W/L	R	.66–.91	.67–.86	.58–.88	.59–.89	.67–.92
	M	.78	.75	.66	.72	.78
	MD	.055	.04	.057	.069	.05

Raceme exposure.—Three distinct types are evident in this character. At one extreme the racemes of the Absaroka and Blue Mountain Areas are little or not at all exposed at the opposite extreme those of the Deschutes, North and South Cascade, Sierra, Rogue, and Puget Areas are entirely exposed; midway in the series the Columbia Area alone has a population whose racemes are consistently half exposed.

Length of wing.—Four types are noted. The Absaroka and Puget Areas represent the extremes of short and long wings, respectively. North and South Cascade, Sierra—1, Rogue, and Deschutes comprise a group with wings of medium length, while the Columbia and Blue Mountain Areas along with the Sierra—2 plants constitute a fourth group whose populations have a wing length intermediate between them and the extreme represented by the Puget Area.

Banner W/L ratio.—In this character the Absaroka Area stands out at one extreme in having an exceptionally narrow banner. The fact that the area exhibits a narrow range and small mean deviation for this character lends significance to this point. The North Cascade mean stands out distinctly from those nearest it, but here the range and mean deviation for the banner ratio are twice those of the Absaroka Area.

With data before us on the geographical distribution of the diagnostic characters we are able to distinguish several morphological types in the population

Fig. 5.—Relative positions of the means in each area for each of the six diagnostic characters. A—Absaroka. B—Blue Mountains. C—Columbia. D—Deschutes. NC—North Cascade. P—Puget. R—Rogue. S-1, S-2—Sierra. SC—South Cascade.

as a whole on the basis of possession of certain combinations of these characters. These types are seven in number, each constituting a biological entity. In general it is found that each type is identified with one of the areas upon which the investigation is based. Dispensing for the moment with detailed measurements of morphological features, we may describe these entities in the following general terms:

1. Plants of medium stature, leaves, and racemes, the latter completely exposed. Geographical range: Deschutes Area.

2. Low stature, small leaves, short racemes completely exposed, medium wing length. Geographical range: North and South Cascade Areas and high altitudes of the Sierra Area.

3. Tall stature, large leaves, long racemes half exposed. Geographical range: Columbia Area.

4. Medium stature, large leaves, medium racemes completely hidden by the foliage, moderately broad banner. Geographical range: Blue Mountains Area.

5. Medium stature, leaves, and racemes, the latter completely hidden, narrow banner, short wings. Geographical range: Absaroka, Sawtooth, and other Rocky Mountain areas.

6. Moderately tall stature, large leaves, long racemes completely exposed, medium wing length. Geographical range: Rogue Area and lower and middle altitudes of Sierra Area.

7. Similar to No. 6 but taller, larger-flowered. Geographical range: Puget Area.

In undertaking the systematic treatment of a group of plants the writer takes the view that any populations which, when in contact, either do not hybridize or if they hybridize do not produce strong or fertile offspring, are of different species; individuals within the same species, on the other hand, do hybridize freely when in conatct, giving rise to a fertile F_1 generation. A species of wide geographic range may, and usually does, develop genetically fixed morphological or physiological races, thereby maintaining itself under varying ecological conditions. These geographical or ecological races are the subspecies of this paper. Where it is impossible or impractical to carry on experimental work to determine these relationships, subspecies within a given species may be detected in the field by the presence in the region of their line of contact of strong, fertile individuals intermediate between the two forms in one or more morphological characters.

Of the seven population entities just listed, each one intergrades in one or more characters with at least one contiguous population. This relationship is shown schematically in the accompanying figure (Fig. 6), where lines connecting the morphological types indicate a natural intergrading through fertile individuals. The numbers in the figure are those which were used in listing the entities, the names are the subspecific names used in the systematic treatment to follow.

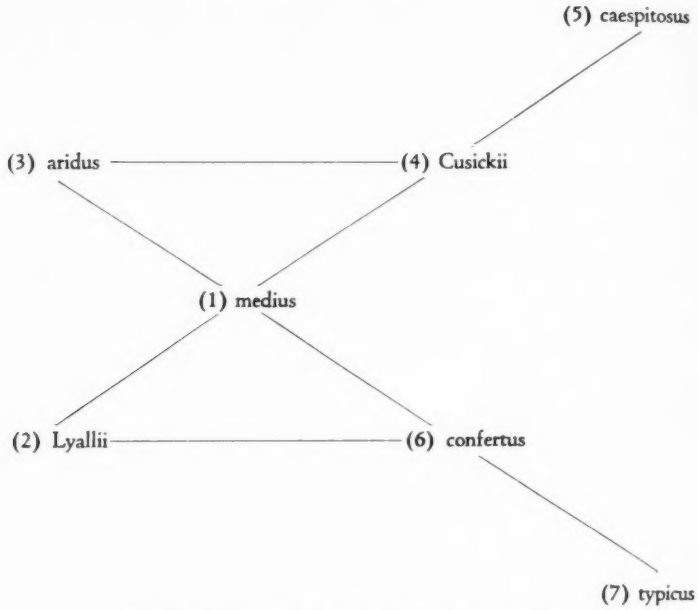

Fig. 6.—Relationships of the subspecies of *Lupinus lepidus*.

In view of the evidence that the various forms of this *Lupinus* complex are interfertile in nature, and in keeping with the species concept previously expressed, the writer considers that all the forms of the *Caespitosi* constitute a single species. In its invasion of regions of varying environmental extremes such as the vegetation areas used in this investigation the species has developed several subspecies in response to these extremes. In general it may be said that each subspecies is limited to a single vegetation area, or at least to areas having similar combinations of climatic extremes.

This study has been made possible in large part by the loan of collections or the furnishing of photographs of type specimens by the following herbaria. To the curators of these herbaria the writer wishes to express his appreciation of their kindness and cooperation.

BC—University of British Columbia, Vancouver
CGE—Cambridge University, Cambridge, England
DS—Dudley Herbarium, Stanford University, California
GH—Gray Herbarium, Harvard University, Cambridge, Mass.
IDS—Idaho State College, Pocatello
ORE—University of Oregon, Eugene
OSC—Oregon State College, Corvallis
RM—Rocky Mountain Herbarium, University of Wyoming, Laramie

UC—University of California, Berkeley
US—United States National Herbarium, Washington, D. C.
V—Provincial Museum of Natural History, Victoria, B. C.
WILLU—Peck Herbarium, Willamette University, Salem, Oregon
WTC—State College of Washington, Pullman
WTU—University of Washington, Seattle

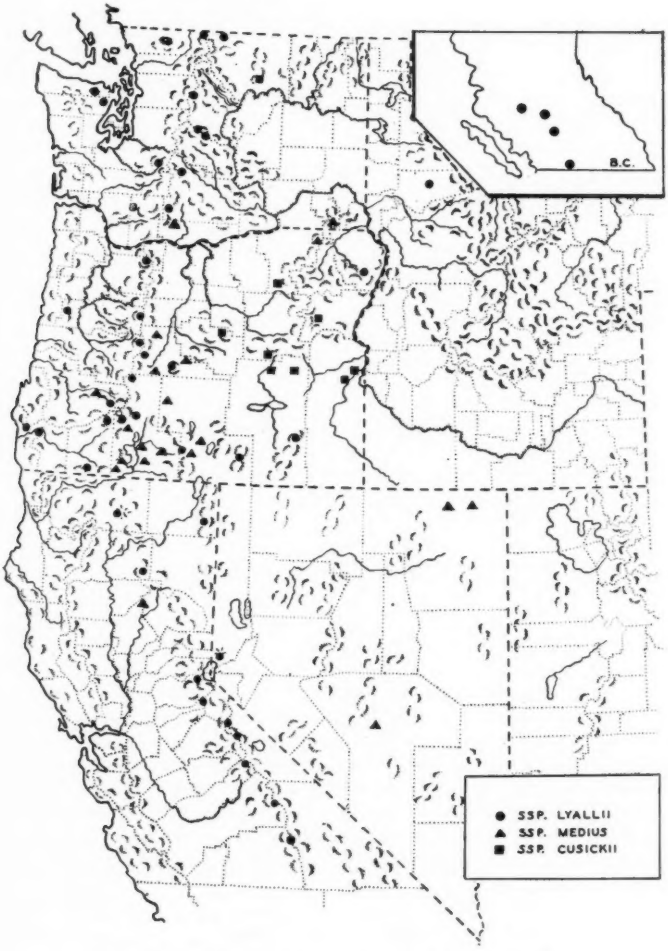

Fig. 7.—Distribution of three subspecies of *Lupinus lepidus*.

LUPINUS LEPIDUS Dougl.

Low perennial plants rising from deep tap-roots surmounted by woody branching caudices. Caudex branches may be short, producing a compact clump of herbaceous stems with most of the leaves coming from their bases, or long, in which case usually prostrate, forming a low spreading mat. Height varying from 4 to 22 cm. Leaves on long petioles. Entire herbage, including both surfaces of the leaves and the pods pubescent with straight stiff hairs, these often fulvous. Inflorescence sub-spicate, the pedicels 1-4 mm. long, quite regularly verticillate. The peduncles in most of the subspecies are sufficiently long to raise the inflorescence well above the foliage, but in others the racemes are hidden to varying degrees. Flowers moderately small for the genus, the wing 7-12 mm. long. Banner obovate, well reflexed from the wings. Keel moderately arcuate, ciliate along the middle but not at the base nor at the tip. Calyx nearly symmetrical at base. Pods 10-15 mm. long, 3-4 seeded. Seeds lenticular, gray or tan when mature.

KEY TO THE SUBSPECIES

A Inflorescence at anthesis completely surpassed by the foliage
- B Flowers small, the wing 7-8 mm. long; banner narrow, width/length ratio less than .60 ..... 5. ssp. *caespitosus*
- BB Flowers larger, the wing 8-10 mm. long; banner wider, width/length ratio greater than .60 ..... 4. ssp. *Cusickii*

AA Inflorescence at anthesis at least partially surpassing the foliage
- C Plants usually prostrate; racemes under 4 cm. long; largest leaflets 14 mm. long or less ..... 2. ssp. *Lyallii*
- CC Plants erect from the crown; racemes over 4 cm. long; largest leaflets over 14 mm. long
  - D Largest leaflets 14-17 mm. long ..... 1. ssp. *medius*
  - DD Largest leaflets over 17 mm. long
    - E Inflorescence about one-half exposed above the foliage ..... 3. ssp. *aridus*
    - EE Inflorescence completely exposed
      - F Wing petals 7-10 mm. long ..... 6. ssp. *confertus*
      - FF Wing petals over 10 mm. long ..... 7. ssp. *typicus*

1. **Lupinus lepidus** ssp. **medius** ssp. nov.

Fig. 7

Plantae spissae, caulibus erectis; 7-15 cm. altis; foliis moderate parvis pro specie, foliolis maioribus plerumque 12-17 mm. longis, interdum usque ad 20 mm.; racemis 4-8 cm. longis, folios omnino superandis.

Compact, bushy plants with erect stems. Height 7-15 cm. Leaves moderately small for the species, the larger leaflets mostly 12-17 mm. long, sometimes up to 20 mm. Inflorescence 4-8 cm. long, completely surpassing the foliage.

Type: Detling 6546, in the Herbarium of the University of Oregon, collected August 17, 1949, 3 miles south of Lapine, Deschutes Co., Oregon.

This form has been identified by most systematists with *Lupinus aridus*

Dougl., and most of the herbarium collections have been so named. However, it differs from the mid-Columbia form of the species, of which Douglas' type of *L. aridus* is representative, in its smaller leaves and its completely exposed racemes.

Representative collections.—OREGON, DESCHUTES Co.: Lapine, *Detling* 6546 (type ORE, isotypes BC, CGE, DS, GH, IDS, OSC, RM, UC, US, V, WILLU, WTC, WTU); Millican, *Peck* 13833 (DS, WILLU, WTU). DOUGLAS Co.: Twin Lakes Mt., *Detling* 4998 (ORE). KLAMATH Co.: Swan Lake, *Maguire & Holmgren* 26572 (UC); Klamath Marsh, *Cusick* 2998 (ORE, UC); Beattie, 5 mi. e., *Peck* 15201 (WILLU); Lake-of-the- Woods, *Thompson* 13101 (WILLU, WTC, WTU); Four Mile Creek, *Applegate* 4698 (DS, WILLU). LAKE Co.: Elder Creek, *Jorgensen* 157 (UC); Paisley, *Peck* 15643 (DS, WILLU, WTU), *Constance* 9633 (ORE, WTC). UMATILLA Co.: Langdon Lake, *Peck* 22262 (WILLU).

CALIFORNIA. BUTTE Co.: Jonesville, *Copeland* 377 (DS, ORE, UC).

WASHINGTON. COLUMBIA Co.: West Oregon Butte, *Darlington* 76 (WTC). KLICKITAT Co.: Glenwood, *Flett* 1258 (WTC).

IDAHO. OWYHEE Co.: Mud Flat, *Maguire & Holmgren* 26305 (DS, UC, WTU).

NEVADA. ELKO Co.: O'Neil, 10 mi. s., *Holmgren et al.* 181 (OSC, WTU); Hot Creek Reservoir, *Maguire* 16878 (UC, WTU). NYE Co.: Barley Creek, Monitor Range, *Train* 2723 (UC, WTU).

This is the most centrally located geographically of all the subspecies of *Lupinus lepidus*, and shows the greater degree of intergrading with contiguous forms. The major population occupies the western portion of the Deschutes Area, from Klamath Lake to the Ochoco Mts., and from the eastern base of the Cascades to Harney Co. It is more common where associated with the *Pinus ponderosa* and *P. contorta latifolia* forests, less frequent in the sagebrush-juniper association. Of considerable interest from an evolutionary standpoint are several outlying populations of *medius*. A small one in the Klickitat Valley, Washington, is separated from the main body by the subspecies *aridus* in the Columbia Area. Another small population, occurring on the lower slopes of the northwestern Blue Mts., is separated from its Deschutes relatives by the Blue Mt. *Cusickii*. A few collections from Elko and Nye Counties, Nevada, are apparently to be included in this subspecies. Other collections localized in northern Butte and Plumas Counties, California, and again on the west slopes of the Cascade Mts. of Douglas and Lane Counties, Oregon, must be classified as *medius*, although they partake considerably of the characteristics of subspecies *confertus*. The California population is separated from the main Deschutes body by the northward extension of *confertus* in the Washoe and Siskiyou Areas, while the western Oregon plants are isolated by the intervening *Lyallii* population of the high Cascades.

This peculiar discontinuity in the distribution of subspecies *medius* suggests that it is the more primitive form originally occupying a much more extensive territory whose boundaries included the present small isolated localities, and that it was subsequently displaced by the younger subspecies *aridus*, *Cusickii*, *confertus*, and *Lyallii*, which originated and developed under changing environmental conditions in the areas they now occupy.

2. **Lupinus lepidus** ssp. **Lyallii** (Gray) comb. nov.

Fig. 7

Lupinus Lyallii Gray, Proc. Amer. Acad. 7: 334. 1868. *Lupinus dancus* Gray, Proc. Amer. Acad. 7: 335. 1868. *Lupinus Lobbii* Gray ex S. Wats., Proc. Amer. Acad. 8: 533. 1873. *Lupinus aridus* var. *Lobbii* (Gray) S. Wats., Proc. Amer. Acad. 8: 533. 1873. *Lupinus Lyallii* var. *danaus* (Gray) S. Wats., Proc. Amer. Acad. 8: 534. 1873. *Lupinus hypoleucus* Greene, Leafl. Bot. Obs. 1: 74. 1904. *Lupinus alpinus* Heller, Muhlenbergia 6: 22. 1910. *Lupinus pinetorum* Heller, Muhlenbergia 6: 25, Pl. 1. 1910, not Jones, 1898. *Lupinus washoensis* Heller, Muhlenbergia 6: 72. 1910. *Lupinus paulinus* Greene, Leafl. Bot. Obs. 2: 234. 1912. *Lupinus fruticulosus* Greene Muhlenbergia 8: 117. 1912. *Lupinus perditorum* Greene, Muhlenbergia 8: 117. 1912. *Lupinus Lyallii* var. *fruticulosus* (Greene) C. P. Sm., Bull. Torrey Club 51: 303. 1924. *Lupinus aridus* var. *washoensis* (Heller) C. P. Sm., Bull. Torrey Club 51: 303. 1924. *Lupinus Lyallii* var. *Lobbii* (Gray) C. P. Sm. in Jepson, Man. Fl. Pl. Calif. 525. 1925. *Lupinus Lyallii* var. *villosus* Jepson, Flora Calif. 2: 267. 1936. *Lupinus danaus* var. *bicolor* Eastw., Leafl. West. Bot. 2: 201. 1939. *Lupinus minutifolius* Eastw., Leafl. West. Bot. 2: 267. 1940 *Lupinus oreocharis* Eastw., Leafl. West. Bot. 3: 171. 1942. *Lupinus rubro-soli* Eastw., Leafl. West. Bot. 3: 203. 1943.

Type: Lyall; summit of the Cascade Mts., latitude 49°. In the British Museum, South Kensington, England.

Low plants, the woody branches from the root crowns up to 15 cm. long and prostrate, the herbaceous shoots rising only 4-8 cm. from these. Leaves smallest of the species, the largest leaflets averaging 7-14 mm. in length. Racemes 2-4 cm. long, fully exposed above the foliage.

Subspecies *Lyallii* occupies the higher elevations of the North and South Cascade and Sierra Areas. It also occurs on some of the high peaks of adjacent areas, as Steens Mt. and Hart Mt. in eastern Oregon, Mary's Peak in the Oregon Coast Range, and in the Olympic Mts. It is occasional in the Siskiyous where it reaches almost to the coast in Curry Co. We have seen one collection from the Wallowa Mts. and one from northern Idaho. Apparently it is not to be found in the Okanogan Highlands.

On the east slope of the Cascades in Oregon, where it is in contact with ssp. *medius*, it intergrades closely with the latter, many individuals being extremely difficult to classify.

A particularly pubescent form (*L. danaus* Gray) occurs sporadically at stations in the southern Sierra Nevada and as far north as Crater Lake. Another variant consisting of individuals of especially woody form and widespreading habit was segregated as *L. fruticulosus* by Greene. This form is not restricted in distribution and intergrades completely with the general population.

In the southern and central Sierra Nevada an interesting morphological gradient occurs, corresponding to the elevation of the habitat. At the very highest altitudes the plants cannot be distinguished in any features from those of the Cascade Mts. of Oregon, Washington, or British Columbia. As elevation decreases, however, leaves become larger and racemes tend to become longer and denser as the plants take on features of ssp. *confertus* of the middle and lower elevations of the Sierra. It was from this large form that the type of *L. Lobbii* Gray was taken, and in a more extreme case the type of *L. washoensis* Heller.

Representative collections.—CALIFORNIA. ALPINE CO.: Sonora Pass, *Constance* 2459 (UC). EL DORADO CO.: Glen Alpine, *Blasdale*, VI/'23 (UC), *Lathrop*, VI/19/'09 (DS). FRESNO CO.: Humphreys Basin, *Sharsmith* 3126 (UC); Mt. Goddard, *Hall & Chandler* 707 (US). INYO CO.: Piute Pass, *Ferris* 8895 (UC, DS). MADERA CO.: Garnet Lake, *J. T. Howell* 16421 (UC). MARIPOSA CO.: Lyell Cirque, *Schreiber* 1794 (DS, UC, WTC). MODOC CO.: Warren Peak, Warner Mts., *Applegate* 8050 (DS), 8051 (DS). MONO CO.: Mt. Conness, *Coulter* 3 (VII/19/'32) (DS, RM). SHASTA CO.: Mt. Lassen, *Copeland*, VII/15/'32 (UC), VII/'30 (UC). SISKIYOU CO.: Wagon Camp—Horse Camp, Mt. Shasta, *Cooke* 11463 (DS, OSC, UC); Dry Lake Lookout, *M. & R. Ownbey* 1763 (WTC). TULARE CO.: Mt. Whitney, *Hall & Babcock* 5542 (UC). TUOLUMNE CO.: Sonora Pass, *Bolt* 370 (UC), *Wiggins* 8144 (DS); Mt. Dana, *Sharsmith* 353 (UC), 146 (UC). COUNTY UNDETERMINED: "High Sierras of California," *Lobb*, 1857 (type specimen of *L. Lobbii;* photograph of Herb. Kew specimen, UC).

NEVADA. WASHOE CO.: Alum Creek, *Heller* 9748 (isotype of *L. pinetorum* and *L. washoensis*, DS, ORE, RM, WTC); Mt. Rose, *Heller* 9914a (isotype of *L. alpinus*, DS, ORE, RM, WTC).

OREGON. BENTON CO.: Mary's Peak, *Henderson*, VII/21/'81/(ORE), *Gilbert* 1174 (OSC). CLACKAMAS CO.: Mt. Hood, *Howell* VIII/'80 (ORE, OSC, UC), *Thompson* 3374 (DS, WILLU). CURRY CO.: Bear Camp, *Leach* 1692 (ORE); Rocky Peak, *Peck* 8930 (WILLU). DESCHUTES CO.: Paulina Lake, *Leiberg* 550 (isotype of *L. paulinus*, UC); Elk Lake, *Peck* 14341 (DS, WILLU). DOUGLAS CO.: Bailey Mt., *Applegate* 4121 (DS, UC); Diamond Lake, *Applegate* 4805 (DS). HARNEY CO.: Steens Mt., *Thompson* 12107 (DS, UC, WILLU, WTC), *Cusick* 2040 (ORE, UC, WTC), *Henderson* 6132 (isotype of *L. minutifolius;* number misquoted by Eastwood, ORE). HOOD RIVER CO.: Mt. Hood, *Thompson* 5040 (DS, OSC), *Abrams* 9445 (DS, RM, WILLU). JACKSON CO.: Ashland Peak, *Thompson* 12383 (UC); Rogue River, *Applegate* 2636 (isotype of *L. perditorum*, DS). KLAMATH CO.: near Crater Lake, *Mrs.* RM, WILLU). JACKSON CO.: Ashland Peak, *Thompson* 12383 (UC); Rogue River, (DS, OSC, UC), *Applegate* 9180 (DS, UC, WILLU); Diamond Lake—Klamath Marsh, *Applegate* 4137 (DS, WILLU); Gearhart Mt., *Applegate* 7935 (DS); Odell Lake, *Peck* 21636 (WILLU). LAKE CO.: Gearhart Mt., *Applegate* 7911 (DS); Hart Mt., *Applegate* 7701 (DS). LANE CO.: McKenzie Pass, *Thompson* 50 (DS); Three Sisters, *Peck* 3987 (WTC). LINN CO.: Santiam Pass, *Detling* 4771 (ORE). WALLOWA CO.: Aneroid Lake, *Peck* 17985 (UC).

WASHINGTON. CHELAN CO.: Mt. Stuart, *Thompson* 7649 (DS, OSC, UC). CLALLAM CO.: Mt. Angeles, *Thompson* 7463 (DS, UC). JEFFERSON CO.: Mt. Constance, *Thompson* 11021 (DS, WTC). KITTITAS-CHELAN COS.: Blewett Pass, *Grant*, VII/'29 (UC). OKANOGAN CO.: Bunker Hill, *Edwards* 32 (WTC). PIERCE CO.: Mt. Rainier, *Thompson* 10013 (DS, UC), *Allen* 100 (DS, WTC). SKAMANIA CO.: Mt. St. Helens, *Thompson* 12653 (WTC, WTU). WHATCOM CO.: Mt. Baker, *Muenscher* 8201 (UC, WTC), 10611 (DS). YAKIMA CO.: Mt. Aix, *Thompson* 15007 (DS, UC, WTC); Mt. Adams, *Suksdorf* 4165 (WTC), 5778 (WTC), *Henderson*, VIII/10/'82 (ORE). COUNTY UNDETERMINED: "Summit of the Cascade Mts., Lat. 49°," *David Lyall*, July 1860 (isotype of *L. Lyallii;* photograph of Gray Herbarium specimen, UC).

IDAHO. CLEARWATER CO.: Lodge and Washington Creeks, *Lingenfelter* 466 (UC).

BRITISH COLUMBIA. Kleena Kleene, 15 mi. s.w., *McCabe* 528 (UC). Mt. McLean, *W. B. Anderson*, VII/11/'26 (V). Lillooet, *E. M. Anderson*, VII/16/'16 (V). Chilcotin, G. V. Copley, VII/15/'25 (V). Timberline Valley, Manning Park, *G. A. Hardy* 18466 (V).

3. **Lupinus lepidus** ssp. **aridus** (Dougl.) comb. nov.

Fig. 8

Lupinus aridus Dougl. ex Lindl., Bot. Reg. 15: pl. 1242. 1829. *Lupinus lepidus* var. *aridus* (Dougl.) Jepson, Flora Calif. 2: 268. 1936, as to type, but not as to description, range, or specimens cited.

Type: Douglas; "the same range of country as *L. leucophyllus*" (which is "from the Great Falls of the Columbia in North America to the sources of the Missouri among the Rocky Mountains"). In the Lindley Herbarium, Cambridge.

Plants somewhat taller than in ssp. *medius*, ranging from 12 to 22 cm. in height, averaging about 14 cm. Leaves much larger, the longer leaflets 20-32 mm. long. Inflorescence 8-15 cm. long, about half exposed above the foliage when in full anthesis. Flowers 9-11 mm. long.

This is the subspecies of the Columbia Area, centered in south central Washington and north central Oregon, and extending up the valleys of the John Day and Metolius Rivers and northward up the Columbia River Valley as far as the Okanogan Highlands. The subspecies intergrades in degree of raceme exposure and leaf size with ssp. *medius* in the plateau region between the Ochoco Mts. and the Cascade Range in Oregon, and in raceme exposure and plant height with ssp. *Cusickii* in the upper valley of the John Day River.

Representative collections.—Exact locality undetermined: N.W. Coast of America, Douglas, 1826. (Photograph of type specimen, CGE).

OREGON. BAKER CO.: Baker, *Gale* 174 (DS). CROOK CO.: Grizzly Butte, *Leiberg* 226 (ORE, UC). DESCHUTES CO.: Redmond, *Peck* 19867 (UC, WILLU). GILLIAM CO.: Blalock, *Thompson* 4713 (DS, OSC); Arlington, *Peck* 19859 (WILLU). GRANT CO.: Kimberley, *Henderson* 5105 (DS); Canyon City, 5 mi. w., *Peck* 19890 (WILLU). SHERMAN CO.: Shaniko, 10 mi. n., *Peck* 13776 (DS, WILLU). UMATILLA CO.: Hermiston, *Gale* 135 (DS). WASCO CO.: Dufur, *Applegate* 4857 (DS, UC); Maupin, *Thompson* 4957 (DS, OSC). WHEELER CO.: Fossil, *Henderson* 5378 (DS); Spray, *Thompson* 11903 (DS, WILLU, WTU).

WASHINGTON: BENTON CO.: Hanford, *Beattie* 3946 (WTC), 3948 (WTC). FRANKLIN CO.: Pasco, *Smith* 3656 (DS). GRANT CO.: Soap Lake, *St. John et al.* 3228 (WTC); Crab and Wilson Creeks, *Sandberg & Leiberg* 311 (UC, WTC). KITTITAS CO.: Vantage, *Thompson* 11441 (DS, UC, WTC, WTU). KLICKITAT CO.: North Dalles, *Thompson* 11110 (WTC, WTU).

IDAHO. IDAHO CO.: Clearwater River, *Davis* 228-37 (IDS).

The identity of *Lupinus aridus* and *L. lepidus* seems frequently to have been confused. The illustrations of the two species in the Botanical Register are far from satisfactory, and the descriptions accompanying them throw little light upon their identity. However, a sheet in the Lindley Herbarium at Cambridge University, which is undoubtedly the type sheet of *aridus*, contains three plants, all of which show plainly the half-hidden racemes of the mid-Columbia population. The specimen bears the notation "N. W. Coast Amer. Douglas. 1826", a geographical term which in Douglas' day might mean anywhere west of the Rocky Mts. from the latitude of central California northward. However, Lindley, in the Botanical Register, says that *aridus* "occupies the same range of country as *L. leucophyllus*," which would certainly place it east of the Cascade Mts. The typical form of *L. lepidus* with its fully exposed inflorescence is restricted to territory west of the Cascades.

According to Lindley, the type material of *aridus* was grown in the gardens of the Horticultural Society from seeds sent by Douglas in 1827.

4. **Lupinus lepidus** ssp. **Cusickii** (Wats.) comb. nov.
Fig. 7

Lupinus Cusickii Wats., Proc. Amer. Acad. 22: 469. 1887. *Lupinus brachypodus* Piper, Bull. Torrey Club 29: 642. 1902. *Lupinus abortivus* Greene, Muhlenbergia 8: 117. 1912. *Lupinus volutans* Greene, Muhlenbergia 8: 118. 1912. *Lupinus aridus* var. *abortivus* (Greene) C. P. Sm., Torrey Club 51: 303. 1924. *Lupinus aridus* var. *Cusickii* (Wats.) C. P. Sm., Bull. Torrey Club 51: 303. 1924.

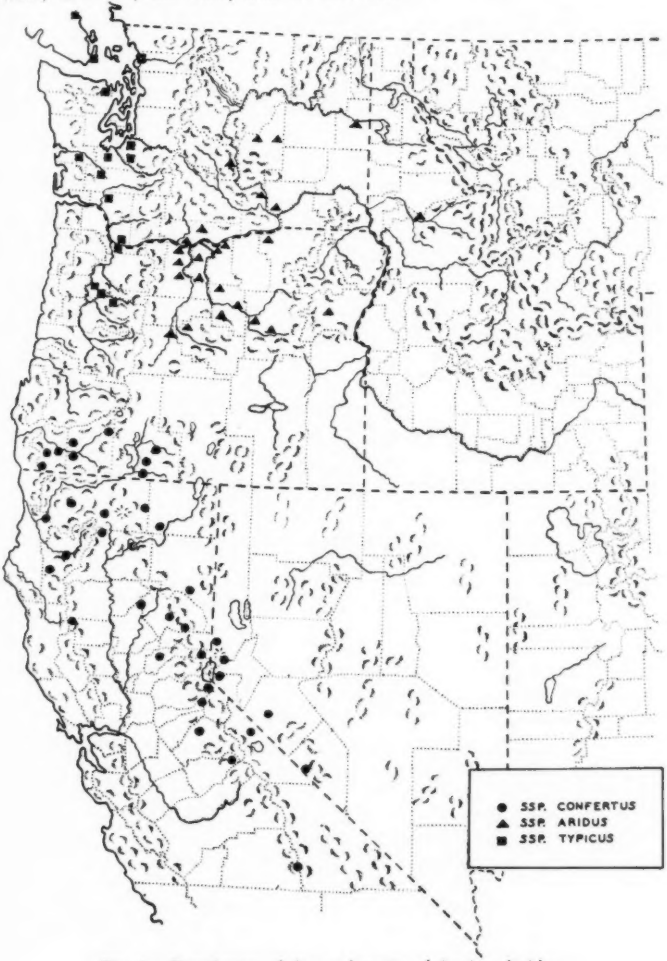

Fig. 8.—Distribtuion of three subspecies of *Lupinus lepidus*.

Type: Cusick 1361; hillsides above the forks of upper Burnt River, Baker Co., Oregon, July 1886.

Plants 9-12 cm. tall. Leaves large, the larger leaflets 20-28 mm. long. Inflorescence 4-5 cm. long, on short peduncles, completely surpassed by the foliage. Flowers 8-10 mm. long; banner broadly obovate, the ratio of its width to length about .7 (.56-.75).

This is the Blue Mountains Area subspecies, occurring in the open dry valleys at the lower altitudes of the Blue Mts. massif, particularly along its southern and western slopes. Reference has already been made to intergradation with ssp. *aridus*. Along the southern borders of the area collections are occasionally made which show the smaller leaves and more exposed inflorescence of ssp. *medius*.

Representative collections.—OREGON. BAKER CO.: Burnt River, *Cusick* 1361 (isotype of *L. Cusickii*, UC, ORE), 2543 (ORE, RM, UC, WTC). CROOK CO.: Big Summit Camp, *Peck* 17201 (WILLU). GRANT CO.: Silvies and Bear Valleys, *Cusick* 2050 (ORE, UC, WTC). HARNEY CO.: Burns, 20 mi. n., *Peck* 20961 (UC, WILLU); Stinking Water, *Leiberg* 2353 (isotype of *L. abortivus*, ORE). MALHEUR CO.: Harper, *Peck* 21309 (UC, WTU); Malheur Valley near Harper's Ranch, *Leiberg* 2227 (type of *L. volutans*, US); Vale, *Leiberg* 2054 (ORE). UMATILLA CO.: Ukiah, *Cusick* 3457 (ORE, WTC). UNION CO.: North Powder, *Gale* 162a (WTU). COUNTY UNDETERMINED: Barren Valley, eastern Oregon, *Cusick* 2561 (isotype of *L. brachypodus*, ORE, WTC).

WASHINGTON. OKANOGAN CO.: Omak, *Fiker* 873 (WTC, WTU), 1227 (WTC).

5. **Lupinus lepidus** ssp. **caespitosus** (Nutt.) comb. nov.
Fig. 9

Lupinus caespitosus Nutt. ex Torr. & Gray, Fl. N. Amer. 1: 379. 1840. *Lupinus aridus* var. *utahensis* Wats., Proc. Amer. Acad. 8: 534. 1873. *Lupinus Watsonii* Heller, Muhlenbergia 1: 114. 1905. *Lupinus amnicoli-cervi* C. P. Sm., Sp. Lup. sig. 32: 561. 1946. *Lupinus sinus-meyersi* C. P. Sm., Sp. Lup. sig. 32: 562. 1946.

Type: Nuttall; "in the grassy valleys of the Rocky Mts., on the Sweet Waters of the Platte and the Colorado of the West." In the British Museum, South Kensington, London.

Similar in many respects to ssp. *Cusickii*, but the plants usually less compact and averaging somewhat smaller, frequently ranging down to 4 or 5 cm. in height. Leaves commonly smaller, the longest leaflets 14-25 mm. as compared with 20-28 mm. in *Cusickii*. Flowers smaller, 7-8 mm. long as compared with 8-10 mm. Inflorescence commonly sessile. The most marked feature distinguishing this subspecies from all others of the species is the narrow banner, the width/length ratio here being quite regularly from .50 to .57.

This subspecies has developed its most typical form in the high mountain regions of the Sawtooth, Absaroka, and other vegetation areas of the northern Rocky Mts., where the climatic extremes are low winter and summer temperatures, short growing season, and high annual precipitation. One of the striking features throughout the subspecies is the inflorescence completely surpassed by the foliage. Typically the inflorescence is sessile or nearly so, but peduncles of varying length may be encountered throughout its range. This is particularly true in populations in the more western areas of its range, where some

of these forms have been segregated as *L. aridus* var. *utahensis* Wats., *L. amnicoli-cervi* C. P. Sm., and *L. sinus-meyersi* C. P. Sm. This pedunculate type, occurring as it does in the territory contiguous to the range of ssp. *Cusickii*, seems to be just one indication of the intergrading of the two populations.

Representative collections.—COLORADO. GRAND CO.: Frasers, *Osterhout* 7608 (RM). GUNNISON CO.: Gunnison, *Baker* 369 (DS, RM). JACKSON CO.: North Park, *Sheldon* 1407 (UC), 114 (DS); Kings Canyon, *E. B. & L. B. Payson* 4271 (RM). LAKE CO.: Leadville, *Clokey* 2744 (UC), *Osterhout* 705 (RM). SUMMIT CO.: Breckenridge, *Mackenzie* 109 (RM).

WYOMING. ALBANY CO.: Wood's Creek, *Goodding* 1426 (DS, UC). CARBON CO.: Big Creek, *Nelson* 3967 (RM). FREMONT CO.: Two-gwo-tee Pass, *Ownbey* 135 (RM). JOHNSON CO.: Powder River Pass, *Porter* 4382 (RM). LINCOLN CO.: Cottonwood Lake, *Payson & Armstrong* 3707 (RM), 3686 (RM). PARK CO.: Powell, *Eckert* S10 (RM). SHERIDAN CO.: South Tongue River, *L. O. & R. Williams* 3096 (RM, WTU). SUBLETTE CO.: Piney Mt., *E. B. & L. B. Payson* 2668 (RM, UC); Fremont Lake, *E. B. & L. B. Payson* 2844 (RM, UC). TETON CO.: Hoback River, *Williams* 1274 (RM). YELLOWSTONE NATIONAL PARK: Norris, *A. & E. Nelson* 5522 (DS, UC); Yellowstone Lake, *A. & E. Nelson* 6626 (UC); Obsidian Creek, *A. & E. Nelson* 6068 (DS, RM).

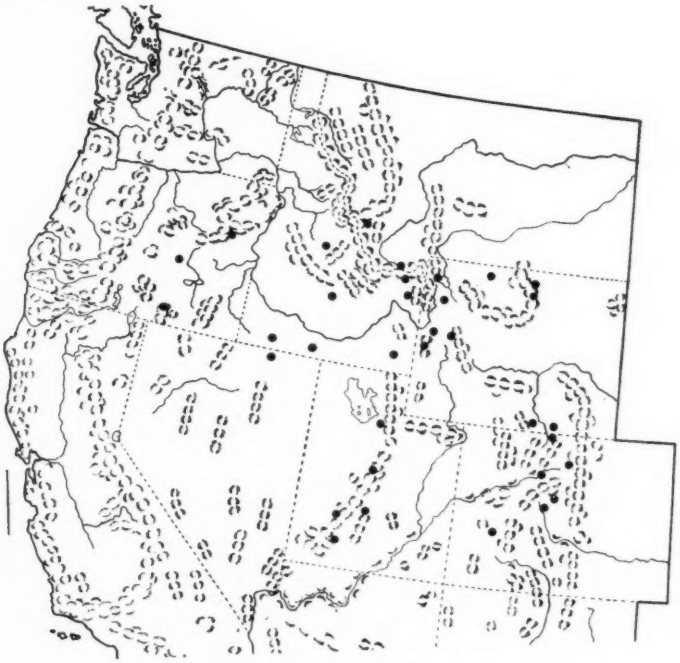

Fig. 9.—Distribution of *Lupinus lepidus* ssp. *caespitosus*.

MONTANA. BEAVERHEAD CO.: Monida, *Smith* 4241 (DS); Big Hole River, *Hitchcock & Muhlick* 12575 (DS, WTU). MADISON CO.: Black Butte, *Hitchcock* 16871 (WTU).

IDAHO. BEAR LAKE CO.: Georgetown Canyon, *Davis*, VIII/16/'32 (IDS, RM). BLAINE CO.: Alturus Lake, *Cronquist* 2664 (IDS). CAMAS CO.: Featherville, *Hitchcock & Muhlick* 8769 (WTU). CLARK CO.: Kilgore, *Cronquist* 1440 (IDS). CUSTER CO.: Wildhorse Creek, *Cronquist* 3248 (IDS). FREMONT CO.: St. Anthony, *Garrett*, V/24/'40 (IDS). LEMHI CO.: Silver Creek, 8 mi. n.e. of Meyers Cove, *Hitchcock & Muhlick* 9468 (isotype of *L. sinus-meyersi*, RM, WTU). OWYHEE CO.: Deer Creek, *Nelson & Macbride* 1844 (isotype of *L. amnicoli-cervi*, RM, WTU). TWIN FALLS CO.: Shoshone R. S., *Gierish* 663 (IDS). VALLEY CO.: Bear Valley, *Hitchcock & Muhlick* 9697 (WTU).

OREGON. BAKER CO.: Unity Dam, *Maguire & Holmgren* 26732 (DS, UC, WTU). HARNEY CO.: Upper Emigrant Creek, *Peck* 2294 (WILLU). LAKE CO.: Hart Mt., *Applegate* 7679 (DS, UC, WILLU).

NEVADA. ELKO CO.: Gold Creek, *Kennedy* 4388 (DS).

UTAH. BEAVER CO.: Puffer Lake Road, *Maguire* 19852 (RM). GARFIELD CO.: Panguitch Lake, *Maguire* 18967 (WTU). SALT LAKE CO.: Alta, *Clemens* VII/7/'08 (DS). SAN PETE CO.: Gooseberry Meadow, *Keck* 704 (DS). SEVIER CO.: Fish Lake, *Jones* 5778 (RM, UC), *Maguire* 20420 (RM).

6. **Lupinus lepidus** ssp. **confertus** (Kell.) comb. nov.

Fig. 8

Lupinus confertus Kell., Proc. Calif. Acad. 2: 192, fig. 59. 1863. *Lupinus Torreyi* Gray ex Wats., Bot. King Expl. 58. 1871. *Lupinus sellulus* Kell., Proc. Calif. Acad. 5: 56. 1873. *Lupinus Culbertsonii* Greene, Leafl. Bot. Obs. 1: 73. 1904. *Lupinus hypolasius* Greene, Leafl. Bot. Obs. 1: 74. 1904. *Lupinus aridus* var. *Torreyi* (Gray) C. P. Sm., Bull. Torrey Club 51: 303. 1924. *Lupinus lepidus* var. *Culbertsonii* (Greene) C. P. Sm., Bull. Torrey Club 51: 304. 1924. *Lupinus lepidus* var. *confertus* (Kell.) C. P. Sm., Bull. Torrey Club 51: 304. 1924. *Lupinus lepidus* var. *ramosus* Jepson, Flora Calif. 2: 268. 1936. *Lupinus lepidus* var. *Torreyi* (Gray) Jepson, Flora Calif. 2: 268. 1936. *Lupinus lepidus* var. *artulus* Jepson, Flora Calif. 2: 268. 1936. *Lupinus sellulus* var. *elatus* Eastw., Leafl. West Bot. 3: 174. 1942.

Type: not stated.

Plants averaging taller and leaves larger than in ssp. *medius;* 8-15 cm. high, the largest leaflets 15-30 mm. long and averaging about 24 mm. Racemes 6-12 cm. long, the flowers crowded. Wing petals 7-11 mm. long.

There is great variation in this subspecies, which extends from the San Bernardino Mts. to the Rogue River and Klamath Lake, at the lower and middle altitudes of both slopes of the Sierra Nevada. In the extreme south the plants are all tall and large-leafed with very long and dense racemes. This type extends northward as far as Honey Lake Valley in Lassen Co., and is closely approximated by collections even from southern Klamath Co. (Applegate, Stukel Mt.). However, from the middle Sierra northward there becomes increasingly interspersed with these a type in which the plants are usually lower in stature and the racemes shorter. This latter type is the only one present in the valleys of the Siskiyou Mts. and the Rogue River. The question arises as to whether the two populations should be given distinct taxonomic status. However, it appears to the writer that there is too much overlapping in their geographical distribution to warrant this. The northern population is probably influenced by the *medius* type of central Oregon, with

its low stature and short open racemes. Indeed, for many collections from northern California and south central Oregon it is difficult to say in which of the two subspecies they should be classified. However, the *confertus* plants can usually be distinguished by their more densely-flowered racemes and larger leaves.

Another noteworthy variation in the *confertus* population occurs in the central Sierra Nevada (Alpine, Amador, and Mono Counties), where the plants become progressively lower in stature and shorter of raceme as one goes toward higher elevations, until at 10,000 or 11,000 feet we find individuals approaching *Lyallii* in stature and in raceme, although never with the small leaves or true prostrate habit of the latter subspecies. It is of interest that in that portion of the northern Sierra where *Lyallii* has not yet been reported we do not find this particular variation in the *confertus* population.

In a quite restricted area of the southern Sierra Nevada several collections have been made of a cespitose lupine with leafy stems and open racemes (*L. Culbertsonii* Greene). We are tentatively including these in ssp. *confertus* as being their nearest relative, although more extensive field studies and possibly cultural and cytological investigation may shed a different light upon their taxonomic status.

Representative collections.—CALIFORNIA. ALPINE CO.: Twin Lake, *Wolf* 5300 (RM, UC). BUTTE CO.: Jonesville, *Copeland* 651 (ORE, UC, WTU). DEL NORTE CO.: Nabar Meadows, *Dudley*, VIII/13/'99 (DS). EL DORADO CO.: Echo Camp, *Heller* 12157 (DS, OSC, WTC, WTU). GLENN CO.: Black Butte, *Heller*, VII/13/'43 (WTU). HUMBOLDT CO.: Klamath River, *Chandler* 1498 (DS, UC). LASSEN CO.: Janesville, *Wolf* 2040 (DS, UC). MARIPOSA CO.: Yosemite Nat'l. Park, *Solheim* 710 (RM, UC). MONO CO.: Bridgeport, *Graham* 197 (UC). NEVADA CO.: Donner Lake, *Heller* 14459 (ORE, UC, WTC, WTU), 9829 (DS, WTC). PLACER CO.: Cisco, *Heller* 13307 (DS). PLUMAS CO.: Limestone Point, *Hall* 9364 (RM, UC); Gray's Flat, *Heller* 15160 (DS, UC, WTU); Taylorsville, *Smith* 3433 (RM). SAN BERNARDINO CO.: Bear Valley, *S. B. & W. F. Parish* 429 (DS, ORE, UC, WTC); Bear Lake, *Clokey* 5268 (UC, WTC). SHASTA CO.: Burney—Fall River Mills, *Heller* 16185 (UC, WTU). SISKIYOU CO.: King's Castle, *Hitchcock & Martin* 5323 (UC, WTU); Medicine Lake, *Applegate* 3846 (DS, UC), 3849 (DS); Upton, *Heller* 12481 (DS, OSC, UC, WTU); Shackleford Creek, *Butler* 1500 (DS, RM, UC). TEHAMA CO.: Morgan, *Hall & Babcock* 4330 (UC). TRINITY CO.: Three Forks of Mad River, *Tracy* 10232 (UC); Hay Fork Mt., *Tracy* 6460 (UC). TULARE CO.: Farewell Gap, *Purpus* 5221 (type of *L. hypolasius*, US), *Ferris & Lorraine* 10695 (RM); Hockett Meadows, *Hall & Babcock* 5589 (UC); Olancha Mt., *Hall & Babcock* 5289 (UC). TUOLUMNE CO.: Pinecrest, *Rose* 42223 (WTC). VENTURA CO.: Piru Canyon, *Dudley & Lamb* 4671 (DS, UC); Griffins, *Elmer* 3891 (DS, UC).

NEVADA. DOUGLAS CO.: Tahoe Juntcion, *Mason* 12171 (DS, UC, WTC, WTU). ESMERALDA CO.: Chiatovitch Creek, *Duran* 3101 (ORE, UC, WTU). MINERAL CO.: Cat Creek, *Alexander & Kellogg* 4482 (UC). ORMSBY CO.: Carson City, *Hitchcock & Martin* 5465 (DS, ORE, WTU). WASHOE CO.: Verdi, *Brandegee*, VII/26/'11 (UC); Franktown, *Heller* 9772 (DS, ORE, WTU), *Smith* 3818 (DS, RM).

OREGON. JACKSON CO.: Prospect, 20 mi. s., *Thompson* 13092 (WILLU, WTC, WTU); Big Applegate River, *Detling* 5621 (ORE). JOSEPHINE CO.: Illinois River, 6 mi. n.w. of Selma, *Constance & Rollins* 2982 (DS, UC, WTU); Waldo, *Thompson* 4628 (DS, OSC); Wilderville, *Detling* 4421 (ORE); Murphy, *Detling* 3664 (ORE). KLAMATH CO.: Lost River, base of Stukel Mt., *Applegate* 5154 (DS, UC, WILLU, WTC); Beattie, 6 mi. w., *Applegate* 7423 (DS); Beattie, 10 mi. w., *Thompson* 13182 (WILLU, WTC, WTU); Olene, *Detling* 4911 (ORE).

7. **Lupinus lepidus** ssp. **typicus** nom. nov.
Fig. 8

Lupinus lepidus Dougl. ex Lindl., Bot. Reg. 14: pl. 1149. 1828.

Type: Douglas; "from Fort Vancouver to the Great Falls of the Columbia." In the Lindley Herbarium, Cambridge.

Similar to ssp. *confertus*, but plants taller (mostly 14-20 cm.), the verticils of the inflorescence not crowded, and the flowers averaging larger, with wing petals 10-12 mm. long.

This subspecies occupies the Puget Area from Vancouver Island south to Salem, Oregon. Unless further exploration reveals stations for this form south of the limits just referred to, there is a notable distributional gap of about two hundred miles between *typicus* and the nearest *confertus* population in the Rogue Area. The fact that occasional intergrading of characters is encountered suggests that the two subspecies may have been in contact in relatively recent times.

Representative collections.—Exact locality undetermined: N.W. Coast of America, *Douglas*, 1827 (Photograph of type specimen, CGE; isotype, GH).

OREGON. MARION CO.: Salem, *Peck* 2277 (WILLU); Stayton, *Detling* 3701 (ORE); Mehama, *Detling* 5739 (ORE). MULTNOMAH CO.: Portland, Howell 1342 (VI/15/'89) (DS, ORE, UC, WTU).

WASHINGTON. CLALLAM CO.: Olympic Mts., *Elmer* 2541 (DS, WTC). CLARKE CO.: Vancouver, *Piper* 4923 (WTC). COWLITZ CO.: Kelso, 15 mi. n., *Hitchcock & Martin* 4754 (UC, WTC, WTU). GRAYS HARBOR CO.: Montesano, *Grant* 928 (WTC). LEWIS CO.: Ford Prairie School, *Smith* 4103 (DS, WTC). PIERCE CO.: Tacoma, *Thompson* 10404 (DS, RM, UC, WTU); Roy, *Smith* 4105 (DS, WTC). SKAGIT CO.: Edison, *Gardner*, VI/'95 (UC). THURSTON CO.: Hawks Prairie, *Meyer* 962 (UC, WTC); Olympia—Gate City, *A. A. & E. G. Heller* 4048 (DS, RM, UC, WTU); Olympia—Tenino, *Detling* 4422 (ORE).

BRITISH COLUMBIA. Beacon Hill, Victoria, *Smith* 4115 (DS), *Henry* 3503 (RM), *Dr. C. F. Newcombe*, VI/15/'20 (BC, V), *Macoun* 133 (V/25/'13) (V).

In the discussion of ssp. *aridus* mention has already been made of the confusion of the types of *aridus* and *lepidus*. The type specimen of *L. lepidus* in the Lindley Herbarium with its long, lax inflorescence, completely exposed above the foliage, is unquestionably from that population occupying the Puget Area. It bears the notation "N. W. America. Douglas, 1827". The type locality as given in the Botanical Register is "from Fort Vancouver to the Great Falls of the Columbia", (i.e., Celilo Falls). *Lepidus* is not uncommon about the site of Fort Vancouver and eastward, although we have no evidence that it occurs beyond the Columbia River Gorge. The seeds which produced the type material of *L. lepidus* in the Horticultural Society's gardens in England were probably collected not far from Fort Vancouver.

A photograph published by Miss Eastwood (1945) in Leaflets of Western Botany, and purporting to be of the type specimen of *L. lepidus* is apparently a second sheet of the type collection of *L. aridus*. The plant is a very good match for those on the type sheet of *aridus*, and bears the same data as does the latter.

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Additional Records of Some Illinois Vascular Plants

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Continued field work in Illinois by several botanists, and subsequent herbarium study, reveals the occurrence in this state of the following thirty species of vascular plants growing spontaneously and apparently well established. These plants have not been previously recorded, or else are known from one or only very few collections. The species mentioned in this paper are arranged in two groups, 1) a list of names of twelve species, two native and ten adventive or introduced, not previously reported as occurring in Illinois, and 2) additional locality records of eighteen species of vascular plants whose occurrence in Illinois is already established in botanical literature. All but five of the cited specimens are in the herbaria of the University of Illinois at Urbana, and the Illinois State Museum at Springfield. Most of the species in this list have come to our attention since the preparation of the second edition of the *Flora of Illinois* (Amer. Midl. Nat. Monograph No. 5, June, 1950). Thanks are due Dr. Reed Rollins, Director of Gray Herbarium, Harvard University for the loan of certain specimens. These are marked (GH).

I. Plants not Previously Reported for Illinois*

1. Native Species

Panicum ovale Ell.—Sand hills, northwest of Bishop, Mason Co., June 4, 1949, *V. H. Chase* 10405. Determined by Mrs. Agnes Chase.

Paspalum glabratum (Engelm.) Mohr—Low ground, four miles north of Cutler, Perry Co., September 29, 1946, *V. H. Chase* & *L. P. Elliott*. Determined by Mrs. Agnes Chase as *P. floridanum* var. *glabratum* Engelm.

2. Adventive or Introduced Species

Aira caryophyllea L.—Abundant at edge of meadow, Allerton Park, near Monticello, Piatt Co., May 30, 1950, *H. E. Ahles* 2429.

Festuca rubra L.—Footpath below golf course, Peoria Heights, June 16, 1948, *V. H. Chase* 9668. Determined by Mrs. Agnes Chase.

* This article was written and submitted for publication before the appearance of Mrs. Agnes Chase's second edition of Hitchcock's *Manual of the Grasses of the United States*. The species of *Panicum Paspalum*, and *Festuca* mentioned above are now attributed to Illinois in the revised *Manual*, hence the specimens here cited merely provide confirmatory collection-data.

Allium perrum L.—Very abundant, 8 miles south of Marshall, Clark Co., May 2, 1950, *H. E. Ahles* 2089; southeast of Albion, Edwards Co., May 12, 1950, *H. E. Ahles* 2145; rocky bluff near Round Bluff, 1½ miles south of Goreville, Johnson Co., June 14, 1948, *G. S. Winterringer* 1541.

Muscari racemosum (L.) Mill.—South of Hecker, Monroe Co., May 20, 1950, *H. E. Ahles* 2004. Seen only in one field, but there very abundant.

Polygonum cuspidatum Sieb. & Zucc.—Moist sunny ravine, Keller, Peoria Co., September 6, 1942, *V. H. Chase* 7907; waste ground, Peoria Heights ("very obnoxious"), August 21, 1950, *V. H. Chase* 11432. Apparently established in a few places in Illinois. Native of Japan.

Lespedeza cuneata (Dumont) G. Don.—Native of eastern Asia; cultivated for forage, game-cover, and as a soil-binder in a few places in southern Illinois; naturalized and occurring spontaneously here and there.—Wooded pasture two miles south of Ramsey, Fayette Co., August 19, 1949, *H. M. Franklin;* near Elkville, Jackson Co., September 4, 1950, *A. F. Grandt.*

Viola priceana Pollard—Edge of field near Lafayette, Stark Co., May 7, 1949, *James Ingels;* established along road, 4 miles south of Marshall, Clark Co., May 2, 1950, *H. E. Ahles* 2085.

Chaerophyllum tainturieri Hook.—This plant is abundant, but probably a recent introduction, as it is seen only along main highways. Carmi, White Co., May 13, 1950, *H. E. Ahles* 2180; 3 miles south of Crossville, White Co., May 13, 1950, *H. E. Ahles* 2175; west of Shawneetown, Gallatin Co., May 13, 1950, *H. E. Ahles* 2237; west of Elizabethtown, Hardin Co., May 14, 1950, *H. E. Ahles* 2280; west of Waltersburg, Pope Co., May 14, 1950, *H. E. Ahles* 2324; northwest of Metropolis, Massac Co., May 14, 1950, *H. E. Ahles* 2333; Vienna, Johnson Co., May 14, 1950, *H. E. Ahles* 2337; south of Benton, Franklin Co., May 15, 1950, *H. E. Ahles* 2342; south of Marion, Williamson Co., May 15, 1950, *H. E. Ahles* 2387.

Hieracium pratense Tausch—Field, Chicago, Cook Co., June 20, 1950, *S. Dvorak.*

Matricaria chamomilla L.—Carmi, White Co., May 13, 1950, *H. E. Ahles* 2179; near Dixon Springs, Pope Co., May 14, 1950, *H. E. Ahles* 2330.

II. Additional Locality-records of Illinois Plants

1. Native Species

Paspalum geminum Nash—G. N. Jones (1945) 63, (1950) 65; Fernald (1950) 193.—Wet soil along road, Cache River bottoms south of Cypress, Johnson Co., October 3, 1948, *G. S. Winterringer* 1662; wet soil, southwest of Murphysboro, Jackson Co., October 2, 1948, *G. S. Winterringer* 1661; ditch along road five miles north of Mt. Vernon, Jefferson Co., October 1, 1948, *G. S. Winterringer* 1724; below bluff facing Mississippi River, Chester, Randolph Co., September 29, 1946, *V. H. Chase & L. P. Elliott* 8578. Determined by Mrs. Agnes Chase as *Paspalum pubiflorum* var. *glabrum* Vasey.

Carex careyana Torr.—Reported by Vasey (1861) 143; Patterson (1876) 48; Brendel (1887) 88; Higley & Raddin (1891) 134; Pepoon (1927) 207; Fernald (1950) 364.—Moist rich woods, locally in the eastern and southern part of the state; known to occur in Champaign, Coles, Cook, Hardin, Jackson, Marion, and Union counties. The following collections are at hand: Moist bottoms near Homer, Champaign Co., May 2, 1914, *A. S. Pease* 14602A (GH); Fox Ridge State Park, along Embarrass River, Coles Co., April 28, 1945, *G. N. Jones* 16697; rocky woods, Blind Hollow, 5½ miles northeast of Cave in Rock, Hardin Co., April 26, 1948, *G. S. Winterringer* 909.

Fimbristylis baldwiniana (Schultes) Torr.—Britton & Brown (1913) 1: 321; Fassett (1940) 141; Fernald (1945) 213, (1950) 262.—Growing in sawdust in lumber yard, Metropolis, Massac Co., August 10, 1950, *H. E. Ahles* 2805. Apparently the first authentic collection in Illinois herbaria.

Iris cristata Ait.—Reported by Bailey (1949) 50.—Colonies in woods, southwest of Lamb, Hardin Co., May 14, 1950, *H. E. Ahles* 2315; bank of stream in Blind Hollow, 5½ miles northeast of Cave in Rock, Hardin Co., April 26, 1948, *G. S. Winterringer* 968.

Cerastium brachypodum (Engelm.) B. L. Robins.—Reported by Britton & Brown (1913) 2: 48; Fernald (1945) 214, (1950) 628.—Along C. & N. W. railroad west of Rockford, Winnebago Co., May 20, 1948, *E. W. & G. B. Fell* (as *C. nutans*).

Chamaesyce vermiculata (Raf.) House.—Attributed to Illinois by Robinson & Fernald (1908) 546, as *Euphorbia hirsuta;* by Britton and Brown (1913) 2: 467, and Pepoon (1927) 373, as *Chamaesyce rafinesquii;* and by Deam (1940) 644, as *Euphorbia vermiculata.* Until very recently, definite evidence in the form of herbarium specimens, at least in Illinois herbaria, that this species is or was a member of the flora of this state, has been lacking. It was not attributed to Illinois by Dr. L. O. Wheeler in his monographic study (Rhodora, vol. 43. 1941). There are, however, three sheets labeled "*Euphorbia humistrata*" in the herbarium of the University of Illinois that are *Chamaesyce vermiculata.* These specimens were collected on roadsides in rich soil, Lake Zurich, Lake Co., Sept. 9, 1898, *E. J. Hill.*

Hypericum boreale (Britt.) Bickn.—Reported by Fernald (1945) 217.—Larchmound, Olney, Richland Co., July 24, 1919, *R. Ridgway* 820 (GH); near Elkville, Jackson Co., July 22, 1941, *J. McCree* 933 (ILL).

Hypericum denticulatum Walt.—Reported by Deam (1940) 675; Fassett (1940) 249; and as *H. virgatum* by Britton & Brown (1913) 2: 533.—Rock near Golconda, Pope Co., July 21, 1948, *G. S. Winterringer* 4026.

Lycopus asper Greene—Reported by Dobbs (1946) 49; Fernald (1950) 1247.—Stony Island, Chicago, August 10, 1909, *J. M. Greenman* 2726 (GH); margin of an old pond about four miles northwest of Geneseo, Henry Co., July 29, 1945, *R. J. Dobbs* 28, 29 (GH).

Aster pringlei (A. Gray) Britt.—Dry sandy ridges, shore of Lake Michigan, Waukegan, Lake Co., Aug. 16 and 17, 1906, *H. A. Gleason & F. D. Shobe* 373, 375 (as *A. dumosus*); Beach, Lake Co., Aug. 24, 1909, *F. C. Gates* (as *A. dumosus*).—Reported (as *Aster polyphyllus*) by Higley & Raddin (1891) 57, "Swamps and low places, infrequent."; and by Pepoon (1927) 500, "Apparently overlooked by most collectors or now vanished."

Senecio obovatus Muhl.—Included in the first edition of *Flora of Illinois* but deleted from the second edition (1950) because the specimen constituting the record was misidentified, but the species recently re-discovered near Kickapoo State Park, Vermilion Co., May 14, 1950, *G. N. Jones* 18960; roadside, 5 miles south of Marshall, Clark Co., May 2, 1950, *H. E. Ahles* 2088.

Solidago buckleyi Torr. & Gray—Fernald (1950) 1391. Reported by Fuller & Jones (1949) 509, as *S. petiolaris.*—Cobden, Union Co., October 5, 1891, *A. B. & A. C. Seymour* 91105, det. by *C. A. Weatherby;* open woods, Atwood Ridge, Union Co., September 16, 1941, *G. D. Fuller* 867 (Ill.); rocky woods on limestone, rare, one mile south of Dupo, St. Clair Co., October 4, 1947, *G. D. Fuller* 13333 (Ill., ISM); dry woods, Carbondale, Jackson Co., Oct. 22, 1940, *Fuller & Welch* 584, also Oct. 13, 1941, *Fuller & Welch* 1292 (ISM); rocky woods, Tamms, Alexander Co., Sept. 28, 1949, *G. S. Winterringer* 2721 (ISM); two miles s. of Eichorn, Hardin Co., Oct. 16, 1949. *H. E. Ahles* 1825. The collection, *Ries* 7559, from Starved Rock, La Salle Co., previously listed as *S. petiolaris,* belongs with *S. hispida.*

2. Adventive Species

Ranunculus sardous Crantz—Reported by Bailey (1949) 51 as *R. parvulus* L.—Below Fountain Bluff, Jackson Co., May 28, 1949, *H. E. Ahles;* Murphysboro, Jackson Co., July 20, 1949, *G. S. Winterringer* 6946.

Lepidium pefoliatum L.—Fuller, Fell & Fell (1949) 73.—Waste ground, Sycamore, Fountain Bluff, Jackson Co., May 28, 1949, *H. E. Ahles* 1124.

Lepidium perfoliatum L.—Fuller, Fell & Fell (1949) 73.—Waste ground, Sycamore, De Kalb Co., June 5, 1945, *G. N. Jones* 17257; along I. C. R. R., 2 miles east of Rockford, Winnebago Co., August 1, 1948, *E. W. & G. B. Fell* 48-227; Fairfield, Wayne Co., May 16, 1950, *Mamie Walker.*

Cynanchum nigrum (L.) Pers.—Pepoon (1927) 434.—Taylorville, Christian Co., May 30, 1899, and August 14, 1899, *W. E. Andrews;* Ravenswood, Chicago, June 24, 1906, *F. C. Gates;* open woods, Peoria, September 27, 1941, *V. H. Chase* 7880; abundant along Route 88, north of Peoria, September 24, 1950, *V. H. Chase* 11629.

Gilia rubra (L.) Heller.—Wherry (1936) 56, says "adventive in Winnebago Co." Recently collected on roadside, Spring Bay, Woodford Co., August 28, 1950, *V. H. Chase* 11486.

Hypochaeris radicata L.—Fernald (1950) 1548.—Waste ground along railroad, near Champaign, Champaign Co., September 23, 1950, *Marilyn L. Briggs.* Only one plant seen.

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New and Infrequently Collected Illinois Plants

Glen S. Winterringer

Illinois State Museum, Springfield, Illinois

This list of thirteen species comprises (1) plants not known to have been previously reported for Illinois, and (2) additional locality-records of certain rare Illinois plants. Those included in the first category were collected during the summer of 1949 and represent species new for Illinois. Specimens are deposited in the herbarium of Illinois State Museum, Springfield, and in the herbarium of the University of Illinois, Urbana. The writer wishes to express thanks to Professor G. Neville Jones, University of Illinois, for assistance in the preparation of this manuscript.

I. Plants not Known to Have Been Previously Reported for Illinois

Spiranthes grayi Ames. (*S. tuberosa* Raf., nom. dub.; *S. beckii* of auth.).—On a rocky ledge on Williams Hill, one mile southeast of Herod, Pope County, 17 August 1948, *G. S. Winterringer* 1537.

Hexalectris spicata (Nutt.) Barnh. (*Arethusa spicata* Walt.).—Rocky hillside, Prairie du Rocher, Randolph County, 13 July 1949, *G. S. Winterringer* 2058.

Apios priceana B. L. Robins.—Damp rich soil, Wolf Lake, Union County, 8 July 1941, *G. D. Fuller* 664; edge of swamp, Pine Hills, east of Aldridge, Union County, 1 November 1949, *G. S. Winterringer* 2492. These two localities are very near each other.

Triadenum tubulosum (Walt.) Gleason.—(*Hypericum tubulosum* Walt.; *T. longifolium* Small.) Low, swampy ground in woods northeast of Mermet, Massac County, 11 August 1949, *G. S. Winterringer* 3538.

Dianthera lanceolata (Chapm.) Small.—In woods one mile east of Karnak, Pulaski County, 11 August 1949, *G. S. Winterringer* 3489.

II. Additional Locality-records of Illinois Plants

Limnobium spongia (Bosc.) Steud.—Reported by Vasey (1861) 142, Patterson (1876) 41, Robinson & Fernald (1908) 86, Rydberg (1909) 74, Britton & Brown 1913 1: 107, Mackenzie (1922) 104, Rydberg (1932) 58, Fassett (1940) 99, Muenscher (1944) 106, Jones (1945) 46. Apparently a rare plant in Illinois. The above nine reports are based probably upon the collection from Jonesboro, Union County, 22 August 1862, by G. Vasey, and a Union County collection by M. S. Bebb.—Shallow water of a pond near Wolf Lake, Pine Hills, Union County, 12 December 1948, *G. S. Winterringer* 1820. East of Aldridge, Pine Hills, Union County, 20 July 1949, *G. S. Winterringer* 2120 and the same locality 27 September 1949, *G. S. Winterringer* 2264.

Rhynchospora corniculata (Lam.) A. Gray.—Reported by Patterson (1876) 46, on the basis of a collection: "Mound City, Pulaski county, Vasey."—Shallow water, edge of swamp east of Olive Branch, Alexander County, 21 July 1949, *G. S. Winterringer* 3453.

Habenaria ciliaris (L.) R.Br.—Reported by Patterson (1876) 42, Higley & Raddin

(1891) 112, Ames (1910) 163, (1924) 44, Pepoon (1927) 237, Correll (1944) 159, Jones (1945) 99.—Collected by E. J. Hill at Calumet in Cook County, 15 August 1864, and recently by G. Pearsall at Elk Grove, Cook County, 20 June 1942, and at Thornton, Cook County, 25 July 1942.

Hypericum denticulatum Walt.—Reported for Illinois (as *H. virgatum*) by Britton & Brown (1913) 2: 533, and as *H. denticulatum* by Deam (1940) 675 and Fassett 1940 (249).—Wet, rocky soil along a roadside south of Rock, Pope County, 21 July 1949, *G. S. Winterringer* 4026.

Jussiaea decurrens (Walt.) DC.—Reported by Gleason (1906)5, Robinson & Fernald (1908) 594, Muenscher (1944) 270, Jones (1945) 190.—Cypress swamp, north of Miller City, Alexander County, 28 September 1949, *G. S. Winterringer* 2706.

Ludwigia glandulosa Walt.—Reported by Patterson (1876) p. 15 (as *Ludwigia cylindrica* Ell.). Attributed to Illinois by Britton & Brown (1913) 2: 587, Rydberg (1932) 571, Fassett (1940) 259, Jones (1945) 190. Described as *L. glandulosa* var. *typica* Munz (1944) 164. Previous Illinois collection: Massac County, H. A. Gleason in wet soil, Metropolis, 16 August 1902. Edge of cypress swamp, south of Cypress, Johnson County, 11 August 1949, *G. S. Winterringer* 3600.

Bumelia lanuginosa (Michx.) Pers.—Reported since 1857 by fourteen authorities as occurring in Illinois, but until lately no Illinois specimens have been known to the writer. It was not attributed to Illinois by the monographer of the genus, R. B. Clark (1942). The following collection is recorded: Limestone bluff, between Fults and Chalfin Bridge, Monroe County, 12 July 1949, *G. S. Winterringer* 2011.

Hydrolea affinis A.Gray.—Reported by Patterson (1876) 31, Gray (1878) 176, Robinson & Fernald (1908) 679, Brand (1913) 184, Muenscher (1944) 307, Jones (1945) 213; and as *H. quadrivalvis* sensu Brendel (1860) 294, Vasey (1861) 142, and as *Nama affinis* (A.Gray) Kuntze by Britton & Brown (1913) 3: 71. Although reported for Illinois by nine different authorities, the reports appear to rest exclusively upon old collections made by Frederick Brendel in Pulaski County and in Union County in 1860. The following recent collection can be reported: — Shallow water at edge of a pond east of Aldridge, Union County, 20 July 1949, *G. S. Winterringer* 2025, and from the same locality 27 September 1949, *G. S. Winterringer* 2265.

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Notes and Discussion

Addendum to "The Loci of Contact Chemoreceptors in Insects."

In our review article, *The Loci of Contact Chemoreceptors in Insects* (Amer. Midl. Nat. 41 (3): 602-658, 1949), one article was missed and another reference was left in question. These difficulties can now be rectified.

Bolwig (1946) has published an interesting paper on the sense organs of fly larvae, among which he described organs which he considered probably gustatory. On the cephalic lobes, there are the terminal organs found on the tips of the lobes, and the ventral organs found on the ventral side of the lobes. In the mouth and pharynx there are the following: 1. small papillae near the lip, 2. a pair of organs at the entrance to the pharynx (hypostomal organs), 3. a pair of organs in the epipharyngeal sclerite (epipharyngeal organs), 4. a pair of very minute sense organs in the roof of the pharyngeal cavity just posterior to the epipharyngeal organs, and 5. dorsal and ventral organs in the pharynx near the posterior end of the cephalo-pharyngeal skeleton (probably "Organ X" of Keilin). He described all these in considerable detail.

In an attempt to study the gustatory sense experimentally, Bolwig tried three sets of experiments. First, he stimulated the terminal organs with sapid solutions on a fine brush, while the maggots were held under a dissecting microscope. Second, he moistened sheets of filter paper on one side with solutions of sugar, salt, acid, or quinine sulfate and on the other side with pure water and then imprisoned larvae on the papers to see whether they would avoid or seek the moistened spots. Third, he mixed the food of the larvae with sapid substances and tested it for acceptance. The results of all the experiments were negative. He concluded that "the experiments have thus apparently led to that indeed very surprising conclusion that fly larvae do not react to tastes. Undoubtedly this conclusion is wrong but further experiments are required to explain the larvae's reactions and the function of what I still prefer to call the gustatory organs." (p. 168)

Bolwig further believes that the sense organs in the stomal and pharyngeal cavities are for taste, but admits that no proofs can be given for such a belief. The organs thus described must, therefore, remain as possible but unproved gustatory organs.

In our review paper, we noted that references were found in the earlier literature to work by a Knoch, supposedly described in Lehmann, and that we could not find this in Lehmann's works. We have since discovered the correct reference. Knoch himself made the statement attributed to him in his book published in 1801. This dealt with beetles and he stated that, for beetles, the maxillary palpi probably serve as olfactory organs, while the labial palpi act as gustatory organs. This belief was based upon observations of beetles during feeding and food-seeking.

It might be noted that, since the publication of the previous paper, the gustatory organs of mosquitoes have been studied with methods similar to those used with the other insects Frings and Hamrum, 1950) and have been located on the labella and tarsi.—HUBERT FRINGS AND MABLE FRINGS, Pennsylvania State College, State College.

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Records of Aristida oligantha Michx. in St. Joseph County, Indiana

A large number of specimens of prairie three-awned grass (*Aristida oligantha*) was observed about 2 miles east of the University of Notre Dame in 1949, Nieuwland Herbarium No. 213883, and 1950, No. 213884. The plants were growing in a sandy area about 40 feet square and were so abundant that they constituted practically a pure stand. Since this species is an annual, it is interesting to note that it has maintained itself from seed in this particular area for at least six consecutive years.

Two previous collections have been made—one (1946) in a ravine near the railroad tracks at St. Mary's College, a mile or so west of the University of Notre Dame; and the other in 1945, two miles west of Notre Dame presumably from the spot reported above. These latter two collections were made by Rev. P. E. Hebert, C.S.C.—A. L. DELISLE, University of Notre Dame, Notre Dame, Indiana.

The Ornate Box Turtle, Terrapene ornata (Agassiz), in Indiana

The ornate box turtle has been previously reported from Indiana only in the northwestern corner of the state, at Lake Maxinkuckee in Marshall County by Evermann and Clark (1930), and in Starke County and the Jasper-Pulaski (Counties) State Game Preserve by Grant (1936). The specimen concerned in this note represents the first locality record for the species in southern Indiana.

This turtle, a male, now University of Illinois Museum of Natural History No. 18038, was picked up September 13, 1950, on Indiana Route 57 five miles south of Plainville in Daviess County. It has the following dimensions: carapace 95 mm. in length, 80 mm. in width; plastron 94 mm. in length, 61 mm. in width; height of shell 43 mm. This specimen, compared with turtles from nearby Illinois counties, differs only in having the dark areas of the plastron more extensive.

Although far from its range in northern Indiana this species is not unexpected in Daviess County. In the northern half of Illinois the distribution of these turtles is generally associated with scattered sand areas, but the animals are found in various habitats across the southern part of the state. In the latter region they occur in a fairly continuous belt from the Mississippi River eastward and northward to Crawford County on the Wabash River, as figured by Schmidt (1938). Smith (1947) records specimens from near Robinson in Crawford County, only 35 miles northwest of the present locality record in Daviess County, Indiana.

Schmidt (1938) predicted the presence of this box turtle in southwestern Indiana by projecting its range eastward from southern Illinois. This was apparently based exclusively on Illinois records of the species. The present record confirms this prediction. In this respect it is interesting to note that Hay (1892) reported from Knox County, the adjacent county to the west of Daviess, a sight record of *Cnemidophorus sexlineatus* (Linnaeus), a lizard commonly associated with *Terrapene ornata* in the sand areas of northern Indiana and Illinois. Hay's record, however, has not yet been substantiated.—JAMES C. LIST, Department of Zoology, University of Illinois, Urbana.

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BOOK REVIEWS

THE ART OF BOTANICAL ILLUSTRATION. By Wilfrid Blunt. Collins, London and Glasgow. 1950. 304 pages; 46 color plates, 32 black and white plates and 61 text figures. 21s.

This book is included in the series of publications known as *The New Naturalist, A Survey of British Natural History*. Mr. Blunt has given a gratifyingly comprehensive review of the development of plant illustration. He has not limited his work to published illustrations, since many of the plates are from originals which were never intended for publication. His intimate contacts and professional grasp of the subject are reflected in the numerous sources in galleries, museums and private collections, throughout Europe, from which he secured permission to reproduce illustrations.

In scope, the work traces the progress from simple outline representations of paleolithic man, scratched on bone, down to the most highly perfected portraiture of modern times.

The treament, in 24 chapters, is chiefly by periods, most of which were dominated by one or a few artists whose works are regarded as distinctive of the age. A rich background of biographical and historical materials is interwoven with the descriptive evaluations. The reviewer was particularly impressed by the explanation of the origin of the flower pieces which were prominent in the Low Countries, especially in the 16th and 17th centuries. Some of the flowers were so rare that passionate lovers of flowers could secure the service of a competent artist for less than the cost of the individual plant.

For the modern student of botany, Appendix A reprints a series of eight articles on "Botanical Drawing" by Walter Hood Fitch, from *The Gardenes' Chronicle* 1869. These show in line drawings the method of preparing simple, analytical studies of flowers and plants.

Appendix B gives a bibliography of "Some Illustrated Works on British Plants" and is supplemented by Appendix C, "Sources of Further Information."

The following quotation from the Epilogue summarizes the objective of botanical illustration in charming simplicity of expression. "Flower paintings, we have now seen, have been made at different times by diverse types of artists and for diverse purposes: by bold explorers in the cause of science, and by timid spinsters to the glory of God; to record the homely wild flowers of the European homeland, and to make known the gaudy exotics of distant countries; to train the eye of the botanist; to bring knowledge within the reach of the student, or a moment of fleeting pleasure to princes." We may add that the author brings lasting pleasure to all who read his book.—HARLEY J. VAN CLEAVE, University of Illinois, Urbana.

BOTANY—A TEXTBOOK FOR COLLEGES. By J. Ben Hill, Lee E. Overholts and Henry W. Popp. Second Edition. McGraw-Hill Book Co., New York. 1950. 335 figs. 710 pp. $5.00.

The revised edition of this text represents several changes when compared to the first edition. New material incorporating the results of recent researches in botany have been introduced, among which could be mentioned discussion on the role of hormones, vitamins and antibiotics. The treatment of morphology, physiology and the study of the plant parts and organs is full and well "balanced." So is that on the plant groups which latter make up approximately one half of the text. There are 20 chapters, 12 of which, constituting Part I, are devoted to a discussion of the morphology and physiology of the seed plants and 8 constituting Part II, make up the study of the various plant groups. Since the contents are about equally divided in the two parts, the book is readily adapted to a two-semester course.

Because of the rather comprehensive treatment of the subject matter, there is a wealth of material not frequently encountered in elementary texts and yet it is clearly and selectively presented. One great advantage to this volume, in my opinion, is that it is adaptable to the requirements of the course and to the needs of the student. The complete-

ness and orderly presentation of the subject matter permit the instructor to select or to omit any material he wishes. No two instructors, perhaps, emphasize the same material. At the same time, the completeness of the text encourages the better student to broaden his information by supplementing the assignments. In this connection, comments are often heard that this text is particularly easy to use as a reference.

Part I incorporates considerable new information on photosynthesis and metabolism as well as on growth and movement in plants. Brief allusion is also made to "tagged" elements yet sufficient to give the student a clear indication of their import and of their use as "tools" in botany.

Part II is based on the discussion of the plant groups and their classification. Also a comparison of the newer concepts of classification is made with the traditional systems. Brief reference is made to the fossil groups and their relationship to the living phyla is clearly indicated. In Chapter 19, there is an adequate summary of the easily recognized and outstanding families of angiosperms, supplemented with good illustrations. The subject of heredity is taken up in the 20th and last chapter, a fact which may lead some to question the advisability of deferring the discussion on heredity and genetics till the very last chapter and then rather briefly.

The orderliness and clarity of the presentation, the printing of all new terminology in bold face, as well as its completeness, make this textbook a desirable and worthy one. The absence of subject summaries at the ends of chapters, however, seems a serious omission. It is felt that their inclusion would enhance the text. The drawings and illustrations on the whole are good.

In the reviewer's opinion, this is as thorough and complete a résumé of the fundamentals of Botany as is found in elementary botany texts. It could well be recommended as a textbook for undergraduate majors in botany or for those students who wish a substantial terminal course in the subject. In all cases, it is a very worthy reference book.—A. L. DELISLE, University of Notre Dame, Notre Dame, Indiana.

THE FRESH-WATER ALGAE OF THE UNITED STATES. By Gilbert M. Smith. McGraw-Hill Book Company, Inc., New York. 1950. 719 pages, 559 figures. $10.00.

Students of phycology, as well as all those interested in fresh-water algae, will welcome the second edition of Smith's well-known book. The first edition was published in 1933, and seventeen years is time enough for many new developments in a rapidly growing science. Those familiar with the first edition will note many changes in the present revision, although some of them could have been anticipated by readers of Smith's *Cryptogamic Botany*, Vol. I (1938), also a McGraw-Hill publication. The general plan of organization, whereby the various algal groups from division to genus are characterized and delimited, followed in the first edition, has been preserved in the second.

Accepting the modern conception of the parallel evolution of many plant-body types among algae, as first suggested by Pascher, Smith recognizes seven algal divisions (phyla), coordinate in rank with the Bryophyta, Pteridophyta and Spermatophyta. These are Chlorophyta, comprising Chlorophyceae and Charophyceae; Euglenophyta; Chrysophyta, including Xanthophyceae (Heterokontae), Chrysophyceae, and Bacillariophyceae; Phaeophyta; Pyrrophyta, containing Desmokontae and Dinophyceae, with the Cryptophyceae considered a class of uncertain systematic position; Cyanophyta (Myxophyta); and Rhodophyta. The 477 genera analyzed are distributed as follows among the algal classes: Chlorophyceae 207, Charophyceae 3, Euglenophyceae 25, Xanthophyceae 34, Chrysophyceae 36, Bacillariophyceae 54, Phaeophyceae 1, Desmokontae 1, Dinophyceae 17, Myxophyceae 75, Rhodophyceae 10; and the uncertain Chloromonadales 2, Cryptophyceae 12.

Another important contribution is a summation of Strain's biochemical analyses of algal pigments. All of the classes contain chlorophyll *a*. Only the Chlorophyceae and the Euglenophyceae have chlorophyll *b*. The Bacillariophyceae, Phaeophyceae and Dinophyceae contain chlorophyll *c*. Chlorophyll *d* is found in the Rhodophyceae, and chlorophyll *e* in the Xanthophyceae. All classes contain beta-carotene, but other carotenes occur sparingly in some. Xanthophylls have been found in all the groups, but the num-

ber and kinds vary greatly from class to class. Two phycobilins (phycoerythrin and phycocyanin) occur in both Myxophyceae and Rhodophyceae, but these two substances are not identical in the two classes.

Some phycologists have been uncertain for some time of the systematic position of the Vaucheriaceae because of the predominance of yellow pigments, the occurrence of oil instead of starch, and the belief that the two flagella of a pair in the motile cells may be of unequal length. It has now been definitely ascertained that in three species of *Vaucheria* the pigments are typical of those in the Xanthophyceae. Smith has therefore transferred Vaucheriaceae with its one genus, *Vaucheria*, from the Chlorophyceae to the Xanthophyceae.

Other changes include the transfer of *Urococcus* from Chlorophyceae to Dinophyceae, the substitution of *Haematococcus* for *Sphaerella*, the acceptance of Transeau's concept of the genera composing the Zygnemataceae, the consideration of *Botryococcus* as a doubtful member of the Xanthophyceae, the replacement of *Lagerheimia* with *Chodatella*, and the inclusion of Chloromonadales in a group of uncertain systematic position.

Numerous new genera, especially among the Xanthophyceae, Chrysophyceae and Dinophyceae have been discovered in the United States since the first edition, and these have been included in the revised book. The morphology and certain reproductive features of many genera are now more fully known and discussed. New distributional data have been added, although it is quite impossible to be completely up-to-date.

Classroom use of the volume may suffer a little by the abandonment of consideration of species differences in the smaller genera. Since this feature could not be complete and include the larger genera, unless several volumes were published, the change is probably a good one. The research worker will welcome the citations of literature where authentic, up-to-date descriptions of the species are to be found. The desirable feature of references to literature in the footnotes has been continued and much augmented.

One notices a bit of fuzziness in some of the illustrations used from the first edition. This is not enough to obscure any of the morphological characteristics, and it is not common, but it does detract somewhat from the usual sharpness of Smith's diagrams. Some of the new figures deserve special mention for their excellence, notably those from R. H. Thompson.

The reviewer has long thought that Professor Smith did an excellent job in combining a scholarly report of research with readability, and one is not disappointed in this accomplishment in the present volume. The book will continue to be a landmark among those texts whose objective is to give an over-all general picture of the fresh-water algae, short of monographic treatment.—L. H. TIFFANY, Northwestern University, Evanston, Illinois.

THE CLASSIFICATION OF ANIMALS. By W. T. Calman. Methuen's Monographs on Biological Subjects. John Wiley & Sons, Inc., N. Y. Printed in Great Britain. 1949. 54 pages. $1.25.

Written as an introduction to zoological taxonomy, this little book admirably presents the basic aims and methods simply, concisely, and unconfusedly. In the first two introductory chapters Dr. Calman very briefly discusses the need for classification, the historical development of the 'natural classification,' and classification and phylogeny. Chapter three is devoted to a consideration of the species as the unit of classification, subspecies, and clines. Here it is pointed out that the term 'species' is perhaps impossible to define in a manner satisfactory to everyone and "we may not be quite sure that the word means exactly the same thing in all cases." In the next chapter, on the higher systematic categories and evaluation of characters, is mentioned that unlike species, the higher categories have no objective existence as groups, but are merely convenient devices in handling numbers of species. Calman is of the belief that convergence is more the exception than the rule and plays only a minor role in taxonomy. Chapter five describes the elements of nomenclature, the Linnean system, types, priority, and the international code. In this chapter is found the only noteworthy defect in the book; on page thirty-three Colubridae is given as the family name for cobras instead of Elapidae. The last two chapters treat

of descriptions and diagnoses of species, keys, synonymy, references to literature, illustrations, measurements, museums, and bibliography. In view of the present state of taxonomic knowledge the author wisely stresses that, "The most urgent task confronting the systematist in nearly all divisions of the Animal Kingdom is not that of adding to the number of named species but that of revising and putting in order the species that are supposed to be already 'known'."

To give the unadvanced student an unobstructed view of the purposes and need for systematics this book would be very valuable as required raeding.—R. L. LIVEZEY, University of Notre Dame, Notre Dame, Indiana.

THE ECOLOGY OF ANIMALS. By Charles Elton. Third edition. Methuen's Monographs on Biological Subjects. John Wiley & Sons, New York. Printed in Great Britain. 1950. 97 pages. $1.25.

This little book is primarily meant as a brief survey of the scope and problems of ecology for the general public. In this respect Elton has undoubtedly succeeded. Explaining such an involved field to the non-biological audience is a difficult task. The writing is clear, to the point, and illustrative examples of the various principles are aptly selected. The bases of ecology are condensed into seven short chapters. These are: the scope of animal ecology, ecological surveys, animal inter-relations, habitats, numbers: statistics, numbers: dynamics, and economic problems.

This work was first published in 1933 and the present printing is called the third edition. It should be pointed out that this does not conform to the American usage of "edition." Here, a new edition implies extensive modification and revision of the material; apparently in Britain it does not. References include no title more recent than 1933, and the generalizations and syntheses are based on research of no later date. Consequently the productive period since that time has not been taken into consideration and is the most serious fault of a book dated 1950.—R. L. LIVEZEY, University of Notre Dame, Notre Dame, Indiana.

INSECTS IN YOUR LIFE. By C. H. Curran, Sheridan House, New York. 1951. 316 pp., illus. $3.50.

From his long professional career as a research entomologist and as interpreter of science to the public, Dr. Curran has compiled a series of essays regarding the importance of insects to the human race. A glance at the table of contents fails to reveal any consistent plan of organization. The author seems to enjoy telling of his experiences with insects and their allies. Many of the chapters are based upon his personal research interest as, for example, the one on the mechanics of flight, while others are built around interesting facts that should appeal to the average citizen.

There has been marked inconsistency in the editing of the book, especially in the practice of using capital or lower case initial letters for common names. Most of the illustrations from photographs are good and well chosen but many of the drawings are not above the level of blackboard sketches.

At times, enthusiasm has resulted in conspicuous inconsistencies as, for example (p. 11), where he claims that some insects "seem to have no purpose in life other than that of making man miserable." In another instance he states, unguardedly (p. 12), that "insects themselves, and their habits do not change." Evidently forgetting this introductory overstatement, he later (p. 225) admits "In order that they may survive they have undergone many modifications in habits and structures."

Apparently the author finds delight in the discomfiture of his associates and readers on such matters as the accidental or unavoidable eating of insects. At times his realism in such matters is as difficult to appreciate as the stark realism of some modern pictorial art and literature. Truth is not necessarily always beautiful but so much of it is that over-emphasis on minor matters offensive to the esthetic sense seems uncalled for as an avenue for gaining attention.

On the whole the book is well written and should have wide popular appeal.—HARLEY J. VAN CLEAVE, University of Illinois, Urbana.

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